818

COMMISSION OF THE
EUROPEAN COMMUNITIES

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

CONF-740638-(Absts.)

WORLD HEALTH ORGANIZATION

RECEIVED BY TIC OCT 28 1975

MASTER

International Symposium

Neueste Erkenntnisse in der Beurteilung der gesundheitlichen Folgen der Umweltverschmutzung

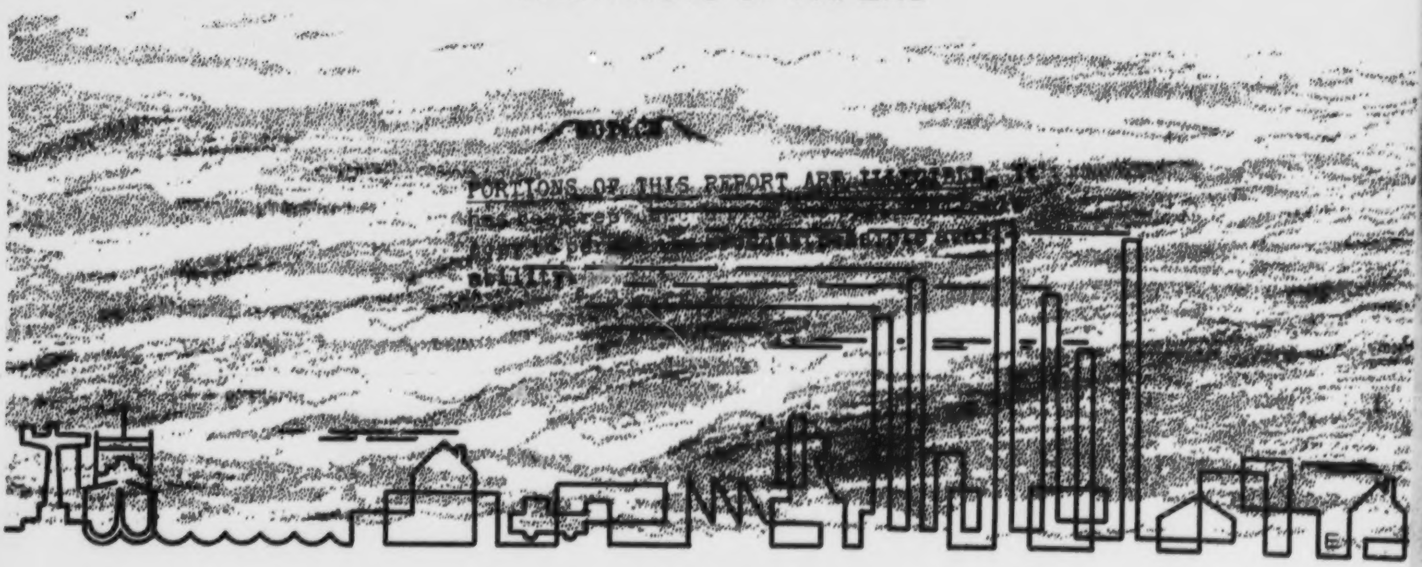
Recent Advances in the Assessment of the Health Effects of Environmental Pollution

Progrès récents dans l'évaluation des effets de la pollution de l'environnement sur la santé

Recenti progressi nella valutazione degli effetti dell'inquinamento dell'ambiente sulla salute

Recente vorderingen bij de vaststelling van de gevolgen van milieuverontreiniging voor de gezondheid

ABSTRACTS OF PAPERS



NOTICE

PORTIONS OF THIS REPORT ARE ILLEGIBLE. It [illegible]
[illegible]
ability.

Paris, 24 - 28 June 1974

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

~~DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED~~

COMMISSION OF THE
EUROPEAN COMMUNITIES

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

WORLD HEALTH ORGANIZATION

International Symposium

Neueste Erkenntnisse in der Beurteilung der gesundheitlichen Folgen der Umweltverschmutzung

Recent Advances in the Assessment of the Health Effects of Environmental Pollution

Progrès récents dans l'évaluation des effets de la pollution de l'environnement sur la santé

Recenti progressi nella valutazione degli effetti dell'inquinamento dell'ambiente sulla salute

Recente vorderingen bij de vaststelling van de gevolgen van milieuverontreiniging voor de gezondheid

ABSTRACTS OF PAPERS

NOTICE

PORTIONS OF THIS REPORT ARE ILLEGIBLE. It has been reproduced from the best available copy to permit the broadestpossible availability.

Paris, 24 - 28 June 1974

~~DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED~~

THE EFFECT OF ENVIRONMENTAL FACTORS ON HEALTH - METHODS FOR POPULATION STUDIES

W.W. HOLLAND

Department of Clinical Epidemiology and Social Medicine,
St. Thomas's Hospital Medical School,
London, United Kingdom.

ABSTRACT - The paper deals with the epidemiological methods and sources of information which are useful for the investigation of the influence of environmental factors on health. Suggestions are made for developments in identification of new health hazards and of monotoring the health of population groups.

HOUSEHOLD SURVEY OF THE INCIDENCE OF RESPIRATORY DISEASE IN RELATION TO ENVIRONMENTAL POLLUTANTS

RALPH I. MITCHELL, MARTIN KELLER, ROGER COTE,
RICHARD R. LANESE , RONALD WILLIAMS

Battelle Columbus Laboratories, Columbus, Ohio (USA)

ABSTRACT - A study was undertaken to determine the incidence of respiratory disease in households of a midwestern suburban community. The community is made up of middle and upper-middle class families, in a relatively unpolluted area. Over 400 families were included in the sample. They were divided into two groups: those utilizing gas cookery and those utilizing electric cookery. Extensive family health and demographic data were obtained. The period of this study is one year, and it will be completed by the end of 1973. Reports of respiratory illness were obtained through biweekly telephone calls to each of the households in the sample. The respondents were asked to report respiratory illness in any member of the household, and to indicate the presence or absence of a set of signs and symptoms of respiratory disease. In addition, ambient air was analyzed, indoors and outdoors, in a sample of the households, and pulmonary function tests were conducted on approximately half of the sample, representative of both types of households.

The results of the study will be presented with regard to the reported incidence of respiratory illness in the two types of households. Automatic interaction detector (AID) analysis will be carried out to determine the best set of independent variables, as predictors of reported respiratory disease incidence, in the study sample. This is meant to be the first in a series of studies. Subsequent studies will relate reported respiratory disease to the objective signs and bacterial cultures.

RELATIONSHIP OF AIR POLLUTION TO PREVALENCE OF LOWER RESPIRATORY ILLNESS AND LUNG FUNCTION IN AUSTRALIAN SCHOOL CHILDREN

S.R. LEEDER, A.J. WOOLCOCK, J.K. PEAT, C.R.B. BLACKBURN

Department of Medicine, University of Sydney, Sydney (Australia)

ABSTRACT - The association of different levels of air pollution with prevalence of past lower respiratory illness and lung function (assessed by maximum expiratory flow-volume curve) was studied in two populations of Australian school children, 2000 in Sydney and 300 in the heavy-industry coastal town of Port Kembla. Levels of pollutants were low by international standards in Sydney but high peaks of sulphur dioxide were recorded in Port Kembla.

Children attending school in the more polluted areas of Sydney and in Port Kembla had the same prevalence of past lower respiratory illness as children in the less polluted regions. A small, statistically significant correlation between reduced forced vital capacity and higher pollution levels was found in Sydney children. This correlation was independent of other factors such as social class and age.

No decrease in maximum expiratory flow rates was found in children in the more polluted areas, when forced vital capacity was included as a covariate. Interpretation of reduced flow rates attributed to pollution is difficult unless changes in vital capacity are taken into account.

RESPIRATORY SYMPTOMS AND VENTILATORY CAPACITY IN A COHORT OF LONDONERS BORN IN 1952 - 53

*R.E. WALLER, *A.G.F. BROOKS, **M.W. ADLER

*MRC Air Pollution Unit, St Bartholomew's Hospital Medical College, London (UK)
**Department of Clinical Epidemiology and Social Medicine
St Thomas's Hospital Medical School, London (UK)

ABSTRACT - The finding that the incidence of chest diseases among children, from a few months of age onwards, was related to the estimated exposure to air pollution prompted an investigation into possible long-term effects of the London fog of December 1952.

In the first stage of the study 800 Londoners who reached age 18 in 1970, and who were exposed to very high air pollution in the neo-natal period were examined in their own homes, using a modified form of the MRC Questionnaire on Respiratory Symptoms. Ventilatory capacity was also measured, using a portable spirometer and a peak flow meter. In the second stage, a further 800 subjects, who reached age 18 in 1971, and who therefore were not exposed to the high pollution in December 1952, were examined in the same way.

Results from these two surveys have now been compared, and no differences have been found in the prevalence of respiratory symptoms, nor in the mean values of FEV_1, FVC and PEF, between subjects born just before the fog and those born just after it.

The prevalence of respiratory symptoms in the sample as a whole is higher than that reported by other workers among adolescents in rural areas: all the subjects had been exposed to high levels of pollution in London in the 1950's. In a further stage of the study it is planned to compare results for Londoners and those for subjects brought up in an area that has always been relatively free from pollution.

Although the subjects have not been smoking for long, respiratory symptoms were much commoner among the smokers than among the non-smokers; there were small differences in ventilatory capacity between these categories. The main factor associated with lowered ventilatory capacity was a history of respiratory illness, and this may be relevant to the finding from the earlier study that the incidence of chest illnesses in childhood is related to exposure to pollution.

A STUDY ON HEALTH INDICES CONCERNING POPULATION IN CADMIUM-POLLUTED AREA

HIROMU WATANABE, H. MURAYAMA

Public Health Institute of Hyogo Prefecture (Japan)

ABSTRACT - Cadmium (Cd) pollution of rice was noticed in the area around Ikuno Mine (located in the central part of Hyogo Prefecture) in the early spring of 1971. Then, Cd health effect surveys were made on inhabitants of 30 years or more (the number, about 13,000), in the area adjacent to them. Based on the results of surveys, the following considerations were made on Cd health effect indices.

1 : Relationship between intake of Cd-polluted rice and urinary excretion of Cd, protein or others, or other results of urinary examinations.
2 : Relationship between aging, Cd intake and urinary excretion of Cd, protein or others, or other results of urinary examinations.
3 : Relationship among types of Disc Electrophoresis globulin fraction pattern, G/A ratio and Cu concentration in urine or hair.
4 : Change of G/A ratio and urinary Cd concentration between two different times, when the suspension of Cd-polluted rice intake was recommended and one year after that.
5 : Follow-up study on renal functions of 13 subjects, who are thought to have been exposed to an especially large amount of Cd judging from their G/A ratios, urinary Cd concentrations and other findings of urinary protein examinations.
6 : Stage of Cd metabolism, classified by urinary excretion and change in G/A ratio.
7 : The meaning of RBP, Lysozyme, β_2-micro-Globulin, Ceruloplasmin in blood or Prolin in urine as the indices of tubular change Cd or Cu intake.

CLINICAL INVESTIGATION IN NORTHWEST QUEBEC, CANADA OF ENVIRONMENTAL ORGANIC MERCURY EFFECTS

A.D. BERNSTEIN

Health and Welfare Canada - Ottawa, Canada

ABSTRACT - In 1971, residents of three Cree Indian communities in Northwest Quebec, Canada, were investigated for possible clinical effects of organic mercury. This was done after finding that mercury levels of fish caught in the area ranged to greater than three parts per million.

In the first phase of the investigation, over three-hundred persons had blood samples drawn for mercury determination. Many of these individuals had hair specimens for mercury determination collected as well. Approximately half this number had field clinical testing done. Clinical evaluation included full or screening types of history and physical examinations, electromyograms, and maze performance testing.

Twenty-two individuals were found to have whole blood mercury levels greater than one-hundred parts per billion, the highest reading being three-hundred-and-six parts per billion. There was good correlation between hair and blood mercury levels. There appeared to be some relationship between the individual's fish consumption and his blood mercury level. No significant clinical findings suggestive of organic mercury excess were detected.

In the second phase of the investigation, five individuals from one of these communities, four of whom had previously shown blood mercury levels greater than one-hundred parts per billion, underwent extensive in-patient evaluations at the Montreal Neurological Hospital in Montreal, Canada. In addition to routine hospital tests, detailed neurological examinations, as well as electroencephalograms, audiograms, visual field determinations, blood cytogenetic studies, electromygram and nerve conduction studies, and blood and hair mercury level determinations were carried out.

Here again, no significant clinical findings suggestive of organic mercury excess were detected.

SCALING OF ANNOYANCE IN EPIDEMIOLOGICAL STUDIES

* BIRGITTA BERGLUND, *ULF BERGLUND, ** THOMAS LINDVALL

*Psychological Laboratories, University of Stockholm (Sweden)
**Departments of Environmental Hygiene, Karolinska Institute
and Swedish Environment Protection Board, Stockholm (Sweden)

ABSTRACT - The paper discusses problems in the measurement of annoyance to environmental factors by survey techniques. Specific problems are discussed such as effects of decision criteria (i.a. attitudes), precision in measurement, validity and comparability between population responses. The result of the analyses show that the assumptions behind the traditional survey methods are not fullfilled. This fact seriously invalidates the usefulness of the various measures obtained. In criteria work the meaningfullness and effectiveness of such data is critical which strongly underlines the need for improvements of the methods. Research on this problem has shown that introduction of modern scaling techniques into surveys gives the necessary improvements of the survey techniques. Investigations on annoyance to pulp mill odors and air craft noise conducted so far demonstrate that it is possible to measure the population response criteria as well as the population response as such. Guidelines are given for annoyance measurements that result in calibrated measures permitting comparisons between differently exposed areas, that fullfil the assumptions for commonly used statistical procedures, and that enable the determination of meaningful dose-response relations.

THE ENVIRONMENT AND THE PROTECTION OF HUMAN HEALTH

EDWARD J. BURGER

Office of the Science Adviser, Washington D.C. (USA)

ABSTRACT - Study of the effects on human health of environmental agents derives its importance because it affords the opportunity for prevention of disease and disability. Environmental health research provides the knowledge base for governmental decisions aimed at avoidance of undesirable or hazardous exposures. A very large universe of chemical and physical environmental agents, both products and by-products of man's endeavors, are treated in this manner. The list extends from the therapeutic drugs and pest control agents to air and water pollutants emanating from industrial effluents.

The case for this activity is a compelling one and the growing breadth of governmental decision processes attests to the importance of this activity. It is interesting to note that in the United States, the long term fall in overall death rates in the first half of the twentieth century was interrupted in the decade of the 1950's by a flattening off and, for males at least, a change in the slope and an actual beginning rise in the crude death rate. This series of "extra" deaths (over and above those which would have been expected from the prevailing trends) are associated with disease processes in which environmental factors have been strongly implicated (e.g., carcinoma of the lungs and other pulmonary diseases).[1] A second, striking observation of the past few years, implicating environmental factors in the condition of disease, of course, has come from the series of migratory studies.[2] In these studies, persons who migrate from one area of the world to take up residence in another appear to adopt the patterns of incidence of disease (notably chronic degenerative diseases) and causes of mortality of their new hosts - in place of those characteristic of their former residence. The implication that it is "something" in the environment which has led to the observed altered disease and mortality patterns is a very strong one indeed.

Thus, the opportunity for prevention of disease is a very attractive one. The extent to which this opportunity is taken rests squarely upon the scientific fabric available for government decisions and upon the way in which this base of scientific information is used in decision-making. Yet, to an unhappy extent, from a governmental point of view, the quality and quantity of the knowledge base for decisions is less than this subject deserves and less than science is capable of offering.

./.

type of research investment whose earnings are redeemed only at some time in the future. Because it is so important, however, it deserves to be supported and consistently sustained.

One of the current scientific challenges for environmental health is the setting of priorities for investigation. The universe of chemical substances, for example, is now very large. Some would say, it is overwhelming and would strike a pose of resignation when asked, where should one make a beginning at improving knowledge of biological effects for this long list of chemical and physical substances. There is, in brief, a compelling need to set priorities for research in some systematic fashion. One suggestion would rest upon an index of probability of human exposure derived from knowledge of physical and chemical properties (from which to infer behavior in the environment) and from knowledge of patterns of manufacture, use and disposal. There is, however, a major accounting problem to be solved if one is to begin to appreciate the routes and rates of distribution of chemicals through the labrynth of man's industrial and commercial activities.

[1] Leading components of upturn in mortality for men, United States, 1952-1962. Department of Health, Education, and Welfare, Publication No. (HSM) 72-1008, Series 20, Number 11. 1971.

[2] Buell, P., and Dunn, J.E., Cancer. 18: 565, 1965.

[3] Chemicals and Health, a Report of the Panel on Chemicals and Health of the President's Science Advisory Committee, Science and Technology Policy Office, National Science Foundation, September 1973.

DESIGNING THE EXPOSURE/RESPONSE MATRIX IN ENVIRONMENTAL HEALTH STUDIES

JOHN H. KNELSON

Human Studies Laboratory, Environmental Protection Agency, USA

ABSTRACT - Assessing the influence of an environmental agent on public health is a difficult multifactorial problem. However, some unifying concepts in research design are now being used to provide a better data base for emission control strategies. The Exposure/Response Matrix is essentially a three-dimensional approach to determining the relationship between environmental stress or insult, and the resulting health effect. One dimension represents pollutant concentration gradient, the second is range of susceptibility within a population and the third is the spectrum of response within population subsets of different susceptibility. This method of approaching study design and interpreting results is applicable to classic toxicology, epidemiology and clinical research.

The pollutant concentration gradient, ranging from background through levels actually occurring in varying geographic areas to those levels recognized as producing overt toxicity must be measured unambiguously and accurately for population studies and reproduced in controlled environmental laboratories for toxicologic and clinical studies. The pollutant gradient or a body pollutant burden is usually treated as the independent variable.

Humans are not uniformly susceptible to various environmental influences on their health. This normal range of susceptibility must be recognized when characterizing the population in an epidemiologic study, when establishing criteria for subject selection in a clinical study, or when preparing animal models of human disease.

Just as there is a range of susceptibility within the population, there is a spectrum of response within each more or less susceptible subset of the population. The range of response is usually a function of pollutant concentration, duration of exposure, and the presence of co-stressors such as exercise, thermal stress, or other co-existing pollutants.

The final goal of environmental health effects research is the construction of this three-dimensional dose-response relationship to calculate risk factors which reflect the degree of hazard, as well as the size of the population at risk for any set of environmental circumstances.

DOSE-RESPONSE RELATIONSHIPS LINKING SHORT-TERM AIR POLLUTION EXPOSURES TO AGGRAVATION OF CARDIO-RESPIRATORY ILLNESSES

R. CHAPMAN, J. FRENCH, J. FINKLEA, H. GOLDBERG

EPA National Environmental Research Center, Research Triangle Park
North Carolina, USA

ABSTRACT - In 1970 and 1971, the U.S. Environmental Protection Agency conducted several epidemiologic studies which assessed the effects on human health of day-to-day fluctuations in air pollution levels. Three of these studies are summarized in this report. Two studies, one in the New York City metropolitan area and one in Utah's Salt Lake Basin, investigated pollution effects in panels of asthmatic children and adults. The third, in the New York area, investigated pollution effects in panels of elderly patients with cardiac, pulmonary, or combined cardiopulmonary disease. In all studies, subjects maintained symptom diaries for about eight months. A total of 359 asthmatics and about 500 elderly panelists participated.

In Utah, outdoor temperature showed a strong negative correlation with asthma attack rates. On subfreezing days, the temperature effect was strong enough to obscure any pollutant effect on attack rates that may have been present. On days of minimum temperature between 30 and 50 degrees Farenheit, response thresholds were estimated at exposure levels of 107 $\mu g/m^3$ for total suspended particulates (TSP) and 17.4 $\mu g/m^3$ for suspended sulfates (SS). No threshold could be estimated on these days for sulfur dioxide (SO_2). On days of minimum temperature above 50 degrees, response thresholds were estimated as follows: 71 $\mu g/m^3$ for TSP, 1.4 $\mu g/m^3$ for SS, and 23 to 53 $\mu g/m^3$ for SO_2.

In New York, temperature was found to exert no consistent effect on asthma attack rates. As in Utah, the estimated response threshold for sulfates was lower on days of minimum temperature greater than 50 degrees than on days of minimum temperature between 30 and 50 degrees (7.3 $\mu g/m^3$ and 12 $\mu g/m^3$, respectively). On the warmer days, no threshold for TSP could be estimated. On days between 30 and 50 degrees, TSP was estimated to promote subtle increases in attack rates at levels as low as 26 $\mu g/m^3$. No consistent effect of SO_2 on asthma was found in New York.

In elderly panels, decreasing temperatures promoted increased attack rates in all but the heart disease panel, for whom the reverse was true. In general, pollutant effects were most severe in cold weather. Pollutant effects were strongest in patients with combined cardiopulmonary disease. Response thresholds for pollutants were estimated at the following levels: 50-70 $\mu g/m^3$ for TSP; about 10 $\mu g/m^3$ for SS, and about 180 μg for SO_2.

EFFECTS OF SOME APPROXIMATIONS IN ANALYSES OF RADIOLOGICAL RESPONSE TO COALMINE DUST EXPOSURE

M. JACOBSEN

Institute of Occupational Medicine, Edinburgh, UK

ABSTRACT - Standards for permissible levels of pollutants are based ideally on reliable information concerning the dose-response relationship in humans. The validity of conclusions based on such epidemiological studies is determined partly by the relevance of the research design to the objectives, but also by the plausibility of assumptions that are made in the course of the statistical analysis of results. An example is the reasoning which led to the introduction of gravimetric standards for airborne dust in British coalmines in 1970.

An interim analysis of results from a longitudinal study in the mines had provided estimates of probabilities of developing various degrees of coalworkers' pneumoconiosis following exposure to different concentrations of respirable dust. These dose-response relationships were used to assess the likely long-term effects of the new standards in terms of maximum risks associated with work in the dustiest conditions and the expected incidence of pneumoconiosis given implementation of the standard. The statistical analysis leading to these inferences required a number of approximations. These included:

1. the use of average concentrations at all coal faces sampled during a ten-year period, as an approximation to average cumulative exposures of the groups of men included in the analysis;
2. the attribution of a single (mean) dust-dose to men working in the same colliery, no allowance being made in the analysis for variations in individuals' exposures within a colliery; and
3. the adoption of a simplified stochastic model of pneumoconiosis progression which took no formal account of the possible effect of variations in dust exposures prior to the start of the research.

Data which became available subsequently have permitted quantitative assessments of how these approximations affected the initial estimates.

The first approximation proved to have little effect on the analysis, there being a very high linear correlation between colliery mean dust concentrations and mean ten-year dust exposures of men grouped according to collieries.

Re-grouping the data according to men's individual dust exposures showed that reliance on the second assumption had resulted in an overestimation of risks associated with high dust concentrations, and to a lesser extent, some underestimation of risks at low dust concentrations.

The third approximation had been used for an extrapolation of results based on 10 years' observations to estimate dust-dose-related probabilities of radiological changes over longer periods. Later calculations have shown that the simplified model resulted in an additional but relatively small overestimation of probabilities at higher dust concentrations.

The results are discussed in relation to the general problem of determining standards for noxious substances with the help of incomplete epidemiological data. The question of screening exposed populations to identify individuals at higher than average risk is considered.

THE CHILD POPULATION AS AN INDICATOR OF THE HEALTH EFFECTS OF AIR POLLUTION

K. SYMON

Institute of Hygiene and Epidemiology, Prague, Czechoslovakia

ABSTRACT - Air pollution effects on the health of the population may be studied by means of diverse methods on different population groups. It is of advantage to conduct such studies on susceptible groups, e.g. children, sick persons or the aged. We have had the best experiences with child groups of 9 - 11 years. Group selection must ensure homogeneity between the exposed and control groups, sufficient numerosity (at least 120 children, 60 boys and 60 girls to a group) and equality of living conditions in terms of the socioeconomic, climatic and dietary background. Indicators of the health effects of air pollution may comprise anthropometric values (weight, height, proportions), blood indices (erythrocyte count and size, haematocrit, haemoglobin, colour index, erythrogram, etc.), other biochemical indicators such as erythrocyte-glutathion values, values for some enzymes (alkaline phosphatase, etc.) or the composition and mutual ratios of blood-serum proteins (albumins, globulins). An apt index of bodily growth is also bone maturation or bone age in relation to calendar age. Changes may furthermore be found in the immunoreactivity of the child organism by investigating secretory immunoglobulin-A levels upon the upper-respiratory-tract mucosa or muramidase-lysozyme levels in the saliva. Some further outstanding indicators of air pollution effects are the state of the cervical lymph nodes, the tonsils including their microflora and the mucous membranes of the upper respiratory tract. The general clinical examination of the respiratory tract is aptly supplemented by respiratory-function values (forced expiratory volume, FEV), etc. In order to obtain valid and comparable data, examination of the children should be organized twice a year (in spring and autumn as a rule), in the exposed and control groups simultaneously and should be conducted by the same team of workers and for three consecutive years (i.e. on a semilongitudinal basis). The results obtained are processed and then compared by the group-evaluation method. In studying the effects of air polluted by specific noxae, specific indicators may also be used. For instance, arsenic intake may be estimated from As levels in the hair, the effects of nitrogen oxides from methaemoglobin levels, etc. Our experiences show that systematic examination of child groups may be a suitable method for evaluating the air-pollution impact on the health of the human population.

VALUTAZIONE DELL'INQUINAMENTO DA RUMORE PRODOTTO DA UNA CENTRALE TERMOELETTRICA SU DI UN QUARTIERE

*F. MERLUZZI, *A. GRIECO, **N. MORRESI, *M. BERNA, *A. DONZELLI

* Clinica del Lavoro "Luigi Devoto", Milano, Italia

** Direttore della Sezione di Acustica Applicata dell'Istituto di Fisica Tecnica del Politecnico, Milano, Italia

---

RIASSUNTO - Lo scopo dell'indagine è stato quello di valutare il disturbo arrecato dalla trasmissione del rumore e delle vibrazioni meccaniche prodotte da una centrale termoelettrica sugli abitanti di un quartiere della Riviera Ligure.

E' stata condotta un'indagine oggettiva consistente nella misurazione diretta del rumore e delle vibrazioni a centrale termoelettrica ferma e in funzione, nonchè un'indagine "soggettiva" rappresentata dalla raccolta mediante un questionario delle opinioni della popolazione del quartiere. Per garantire un elevato numero di risposte, è stato utilizzato un questionario "mirato" e "partecipato" caratterizzato dai seguenti aspetti originali:

a) è rivolto a studiare soltanto i problemi strettamente inerenti la popolazione e le condizioni oggetto dell'indagine;

b) viene preparato con la partecipazione e collaborazione di un gruppo quanto più vasto possibile di soggetti interessati, compatibilmente con le esigenze funzionali e operative.

Sono stati recapitati a domicilio e consegnati a ciascun abitante del quartiere di età pari o superiore a 18 anni, 358 questionari che sono stati totalmente compilati e quindi utilizzati ai fini statistici. I questionari, opportunamento codificati, sono stati elaborati mediante calcolatore elettronico.

La rumorosità misurata di notte all'interno di 6 abitazioni diverse, con le finestre aperte oscillava tra 43 e 32 dBA con la centrale termoelettrica ferma e tra 48,5 e 52 dBA con la centrale in funzione. Le vibrazioni misurate sulla zona centrale di un vetro di una finestra chiusa hanno presentato un massimo di ampiezza per le frequenze comprese fra i 12 e 30 Hz.

I risultati della elaborazione statistica delle risposte del questionario hanno permesso di concludere che il rumore e le vibrazioni della centrale termoelettrica rappresentano per gli abitanti del quartiere una fonte di disturbo talmente grave da poter essere definita "intollerabile".

./.

Gli autori traggono spunto dalla presente indagine per sottolineare l'importanza del questionario quale strumento per la raccolta della soggettività e quindi per la valutazione del grado di disturbo provocato da un inquinante ambientale quale il rumore deve essere considerato.

ASSESSMENT OF NOISE POLLUTION FROM A THERMAL POWER PLANT AND ITS EFFECT ON THE NEIGHBOURHOOD

*F. MERLUZZI, *A. GRIECO, **N. MORRESI, *M. BERNA, *A. DONZELLI

* Clinica del Lavoro "Luigi Devoto", Milan, Italy
** Director, Applied Acoustics Section, Physics Institute, Milan, Italy

---

ABSTRACT - The aim of the survey was to assess the effects of noise and mechanical vibrations produced by a thermal generating station on the inhabitants of a district in the Riviera Ligure region.

Apart from conducting an objective survey consisting of direct measurements of noise and vibrations at the thermal generating station under operational and non-operational conditions, a "subjective" survey was carried out on the basis of a questionnaire on the opinions of the surrounding inhabitants. In order to ensure a large number of responses, an "active" and "passive" questionnaire was used, broken down into the two following categories:

a) a study was made of problems strictly relating to the survey population and conditions;

b) a questionnaire drawn up with the assistance and collaboration of as large a group as possible of interested subjects comparible with the functional and operative requirements of the survey.

Three hundred and fifty-eight questionnaires were completed by means of a door to door survey of all inhabitants over 18 years of age in the neighbourhood and were then used for statistical purposes. After proper coding, these questionnaires were processed by computer.

The noise measured at night inside six different types of home with the windows open varied between 43 and 32 dBA when the generating station was not operating and between 48.5 and 52 dBA when it was. The vibrations measured at the centre of closed window panes were found to be most intense for frequencies from 12 to 30 Hz.

Statistical processing of the replies contained in the completed questionnaires led to the conclusion that the noise and vibrations from the generating station were so disturbing to the inhabitants of the district as to be considered "intolerable".

The authors consider the survey emphasizes the significance of questionnaires as a means of collecting subjective opinions so as to assess the degree of disturbance caused by environmental pollutants, among which noise is certainly to be included.

MERCURY-SELENIUM ASSOCIATION IN PERSONS EXPOSED TO INORGANIC MERCURY

L. KOSTA, A.R. BYRNE, V. ZELENKO

Institute J. Stefan & Medical Faculty, University of Ljubljana, Yugoslavia

ABSTRACT - For the last few years we have been measuring the distribution of mercury in organs obtained from autopsies of persons working in or living around the mercury mine of Idrija, Slovenija. These investigations revealed an unexpected distribution pattern with the very high uptake by thyroid and pituitary glands (by a factor of a thousand) accompanied by a very long biological half life. Kidney, normally considered to be the prime accumulator, ranked only third behind these glands. So far we had eight cases of professionally exposed miners and there was no exception to this pattern. In seven subjects of the general population of Idrija, there was a greater variability but thyroid, pituitary and kidney still showed a considerable increase in concentration as compared to nonexposed persons, with values near background to factors of about fifty. Tables presenting mercury concentrations for three population groups (professional, population, controls) for many additional organs are given. Negligible methyl mercury concentrations have also been found.

Parizek and his group have demonstrated the toxicological interrelationship between mercury and selenium in experimental animals, while recent analytical data by Ganther on tuna and by Koeman on marine mammals indicate a close relationship in the natural concentration of these elements. Therefore we have extended our neutron activation method for mercury to simultaneous determination of selenium and applied it to studies of exposed humans. The results presented show that at elevated mercury levels there is a simultaneous rise in selenium concentrations. In particular, in the three organs with highest mercury levels, namely thyroid, pituitary and kidney in the professionally exposed persons, an approximately one to one molar ratio of mercury to selenium is observed. There is also evidence for a similar trend in the brain. The persistence of high concentrations of both mercury and selenium in thyroids of persons who were not in contact with mercury for several years suggests a very firm binding between the two elements in the tissue. Since the detoxifying effect of selenium has been demonstrated in animals and there is evidently a causal relationship between naturally occurring levels, the parallelism between mercury and selenium is very likely due to a protective mechanism acting in conditions of higher exposure.

METHOD FOR A EUROPEAN STUDY ON POSSIBLE EFFECTS OF AIR POLLUTION IN CHILDREN

PH. BOURDEAU

For the Commission's Working Party of experts on epidemiology,
Commission of the European Communities-Directorate General for
Research, Science and Education - Bruxelles.

ABSTRACT - A coordinated epidemiological survey on the relationship between air pollution and incidence and prevalence of respiratory affections in children has been planned with the participation of about ten institutes in the member states of the E.C.

This broad participation will provide results from a very large number of observations obtained in a significant number of geographical areas categorised according to their air pollution characteristics.

This survey will be carried out by means of a questionnaire (on health and socio-economic status of children) administered by field-workers, of physical measurements (height, weight, pulmonary function) performed on children in the schools, and air pollution measurements, in particular SO_2 and suspended particulate matter.

The protocol for the survey has been developed by a Working Party of experts on epidemiology set up in 1973 to advise the C.E.C. on its Environmental Research Programme in this area.

A pilot study will be first undertaken on a limited number of children in 1974 followed by the main study on 20.000 - 30.000 children in 1975.

PRESENTATION ET DISCUSSION DU PROTOCOLE DE L'ENQUETE EPIDEMIOLOGIQUE FRANCAISE SUR LES RELATIONS ENTRE POLLUTION ATMOSPHERIQUE ET AFFECTIONS RESPIRATOIRES CHRONIQUES

*D. BRILLE, **P. BOURBON, ***J. LELLOUCH, *P. ORIOL

* Unité de Recherche de Physio-pathologie Respiratoire (U.68)
INSERM, Hôpital Saint-Antoine, 75571 PARIS CEDEX 12

** Unité de Recherche de Pollution atmosphérique (U.57) INSERM
31320 VIGOULET AUZIL et Université P. Sabatier TOULOUSE

*** Unité de Recherches Statistiques (U.21) INSERM
16bis, avenue Paul-Vaillant Couturier, 94800 VILLEJUIF.

RESUME - L'objectif de cette étude épidémiologique est double:

- Obtenir les données sur les relations entre la pollution atmosphérique et la prévalence des bronchopneumopathies respiratoires chroniques ou à répétition.

- Etudier le rôle éventuel de certains polluants comme le dioxyde de soufre et les oxydes d'azote.

L'étude est menée dans sept villes disposant d'un réseau de mesure opérationnel depuis plus d'un an. Les moyennes mensuelles des résultats pour l'acidité forte et les fumées noires ont permis de choisir des postes, et autour de ces postes des zones (2 à 4 par ville) dont la pollution a paru contrastée en qualité ou en quantité.

Les postes retenus ont été équipés de manière à pouvoir mesurer, en plus des fumées noires et de l'acidité forte, le dioxyde de soufre par une méthode spécifique, les oxydes d'azote (NO, NO_2), les poussières par gravimétrie.

La population retenue est constituée par des ménages sélectionnés, à partir d'un recensement exhaustif des habitations centrées par le poste de mesure, sur les critères suivants:

- ménages de cadres moyens et employés afin de minimiser les facteurs sociaux et les risques professionnels respiratoires;

- ménages vivant dans la zone depuis trois ans au moins pour que l'exposition à la pollution atmosphérique de cette zone ait pu jouer un rôle dans une pathologie chronique;

- ménages français pour réduire l'hétérogénéité médico-sociale et linguistique.

A l'intérieur des ménages retenus, sont admis à l'enquête:

- les enfants de 6 à 10 ans;

- les adultes de 25 à 59 ans.

./.

Les données médicales sont recueillies à l'aide d'un questionnaire standard (dérivé du questionnaire MRC/CECA) concernant les symptômes et les antécédents respiratoires, et d'un enregistrement spirographique d'une expiration forcée.

Le questionnaire permet par ailleurs d'inscrire, pour en tenir compte au moment de l'exploitation des résultats, le tabagisme (type et quantité tout au long de la vie), les activités professionnelles actuelles et passées, le niveau d'études, les caractéristiques de logement, les déplacements quotidiens.

Il est prévu d'examiner 20 à 25.000 sujets pour l'ensemble des sept régions.

Le protocole et tous les documents ont été élaborés en commun. La coordination est établie au triple point de vue métrologique, épidémiologique et statistique, afin d'harmoniser au mieux l'enquête dans les divers centres.

Pour former le personnel et tester le matériel et les méthodes, une pré-enquête est menée actuellement dans chaque ville. Les résultats et les enseignements de cette pré-enquête seront présentés et discutés.

....

Cette enquête est financée par le Ministère de la Protection de la Nature et de l'Environnement et le Ministère de la Santé Publique et de la Sécurité Sociale.

Etude préparée avec les responsables de l'enquête dans les huit centres suivants :

Bordeaux : P. FREOUR, J.F. TESSIER, M. BERNADOU, . FAUGERE, . DUFOIR
Lille : M. GERVOIS, G. DUBOIS, C. VOISIN, . HOUDRET
Lyon : S. PERDRIZET, J. BOURDEIX, . VIOLET, . GALLY
Mantes : D. BRILLE, P. ORIOL, Cl. BOUDENE, J. GODIN, F. KAUFFMANN
Marseille et Fos : P. LAVAL, J. CHARPIN, A. ARNAUD, J.P. KLEISBAUER, V. VIALA, . SOMMER.
Rouen : J.P. LEMERCIER, A. LECADET, . FLAUGNATI
Toulouse : R. BOLLINELLI, Y. ROUCH, P. BOURBON, . ALARY

PRESENTATION AND DISCUSSION OF A REPORT ON THE FRENCH EPIDEMIOLOGICAL SURVEY ON THE CONNECTION BETWEEN ATMOSPHERIC POLLUTION AND CHRONIC RESPIRATORY AILMENTS

*D. BRILLE, **P. BOURBON, ***J. LELLOUCH, *P. ORIOL

* U. 68, INSERM, Paris, France
** U. 57, INSERM, Vigoulet Auzil and Toulouse, France
*** U. 21, INSERM, Villejuif, France

ABSTRACT - The purpose of this epidemiological study is twofold:
- to obtain data on the connection between atmospheric pollution and the prevalence of chronic or recurring respiratory bronchopneumopathies;
- to study the possible effects of certain pollutants such as sulphur dioxide and nitrogen oxides.

The study is being conducted in seven towns which have had a monitoring network in operation for more than one year. The mean values recorded monthly for strong acidity and black smoke were used in selecting monitoring stations, and around these stations zones (2 to 4 per town) where the pollution appeared to offer certain contrasts in either quality or quantity.

In addition to black smoke and strong acidity, the stations selected were equipped to measure sulphur dioxide by a specific method, nitrogen oxides (NO, NO_2), and dust particles gravimetrically.

The sections of the population **which is to take part in the** survey were chosen following an exhaustive census of homes around the monitoring stations, according to the following criteria:

- households of lower salaried staff, so that social factors and occupational respiratory risks will be minimal;

- households who have been living in the zone for a minimum of three years, so that exposure to atmospheric pollution in this zone will be likely to have had some effect on chronic pathology;
- French households, in order to reduce medico-social and linguistic heterogeneity.

Within the selected households, the following groups are to take part in the survey:

- children aged from 6 to 10 years;

- adults aged from 25 to 59 years.

./.

A standard questionnaire (taken from the MRC/ECSC questionnaire) is to be used to collect medical data on symptoms and respiratory history. A spirographic recording of forced expiration is also used.

So that the relevant data will be available for subsequent analysis of the results, the questionnaire also records details of tobacco consumption (type and quantity throughout the life of the subject), present and past occupations, level of education, type of accommodation and normal daily travel.

It is intended to examine 20 to 25,000 subjects over the whole of the seven regions.

The report and all the relevant documents have been drafted jointly. The work has been coordinated as regards three main aspects - the metrological, epidemiological and statistical - in order to standardize the survey as far as possible in the various centres.

A preliminary survey is currently being carried out in each town, in order to train staff and test material and methods. The results and experience gained from this preliminary survey will be presented and discussed.

....

This survey is being financed by the Ministry for the Protection of Nature and the Environment and the Ministry of Public Health and Social Security.

This study is prepared with the persons in charge of the survey in the following eight centres :

Bordeaux : P. FREOUR, J.F. TESSIER, M. BERNADOU, . FAUGERE, . DUFOIR

Lille : M. GERVOIS, G. DUBOIS, C. VOISIN, . HOUDRET

Lyon : S. PERDRIZET, J. BOURDEIX, . VIOLET, . GALLY

Mantes : D. BRILLE, P. ORIOL, Cl. BOUDENE, J. GODIN, F. KAUFFMANN

Marseille et Fos : P. LAVAL, J. CHARPIN, A. ARNAUD, J.P. KLEISBAUER, V. VIALA, . SOMMER

Rouen : J.P. LEMERCIER, A. LECADET, . FLAUGNATI

Toulouse : R. BOLLINELLI, Y. ROUCH, P. BOURBON, . ALARY

UEBER VERAENDERUNGEN EINIGER BIOLOGISCHER PARAMETER BEI SCHULKINDERN IN GEBIETEN MIT UNTERSCHIEDLICH STARKER LUFTVERUNREINIGUNG

*P. SCHMIDT, *L. PELECH und **R. DOLGNER

* Institut Hygieny a Epidemiologie, Prag, Tschechoslowakei
** Medizinisches Institut für Lufthygiene und Silikoseforschung, Düsseldorf, B.R.D.

KURZFASSUNG - Eine Möglichkeit, die Einflüße der Luftverunreinigung auf die menschliche Gesundheit zu untersuchen, ist das Studium von Populationsgruppen in luftverschmutzten Gebieten im Vergleich mit Kontrollgruppen in Regionen mit relativ reiner Außenluft. Hierzu können verschiedene Bevölkerungsteile und unterschiedliche Wirkungsparameter herangezogen werden. Wir untersuchten in den Jahren 1968 bis 1973 ausgewählte Kinderkollektive in der CSSR, der DDR und der Bundesrepublik Deutschland im Hinblick auf sog. Nondisease effects und wandten dabei das Prinzip der Gruppendiagnostik an. Wir fanden bei den exponierten Kindern wiederholt ein häufigeres Vorkommen von vergrößerten und zerklüfteten Mandeln, von vergrößerten regionären Lymphknoten und von pathologischen Keimen auf der Tonsillenoberfläche sowie einen verminderten Muramidasespiegel im Speichel. Diese Kinder waren regelmäßig in ihrer Knochenreifung relativ verspätet, und sie zeigten eine relativ hohe Erythrozytenzahl sowie Veränderungen des Hb_E-Wertes und der chemischen Hämolyse; die Methode der Chemoresistenzprüfung (Erythrogramm) wird speziell beschrieben. Die Diskussion der Befunde vor dem Hintergrund tierexperimenteller und anderer epidemiologischer Daten macht die bei den exponierten Kindern beobachteten Abweichungen als Effekte der Luftverunreinigung wahrscheinlich und bestätigt durch den von uns positiv geführten internationalen Vergleich die Allgemeingültigkeit der Ergebnisse.

CHANGES IN SOME BIOLOGICAL PARAMETERS IN SCHOOL CHILDREN FROM AREAS WITH VARYING DEGREES OF AIR POLLUTION

*P. SCHMIDT, *L. PELECH and **R. DOLGNER

* Institut Hygieny a Epidemiologie, Prague, Czechoslovakia
** Medizinisches Institut für Lufthygiene und Silikoseforscnung,
Düsseldorf, Federal Republic of Germany

ABSTRACT - One method of investigating the influences of air pollution on the health of human beings, is to study population groups in air-pollution areas and compare them with control groups in regions with relatively clean ambient air. Various sections of the population and differing effect parameters can be used. From 1968-1973 we examined selected groups of children in the Czeckoslovak Socialist Republic, in the German Democratic Republic and the Federal Republic of Germany with regard to what are known as non-disease effects, using the principle of group diagnosis. In the children who were exposed, we repeatedly found a more frequent occurrence of enlarged and fissured tonsils, enlarged regional lymphatic ganglions and pathological germs on the tonsil surface, as well as a reduced muramidasis level in the saliva. These children were regularly relatively late in reaching bone maturity and they had a relatively high erythrocite count as well as alterations of the Hb_E figure and of the chemical hemolysis; the method of testing the chemo-resistance (erythrogram) is specifically described. The discussion of the findings against a background of laboratory animal and other epidemiological data indicates that the anomalies observed in the exposed children were the effects of air pollution, and confirms the general validity of the results by means of an international comparison.

AIR POLLUTION AND RESPIRATORY DISEASE IN BRITISH SCHOOLCHILDREN

L. IRWIG, D. ALTMAN, J. GIBSON AND CHARLES DU V. FLOREY

St. Thomas's Hospital Medical School, London, England.

ABSTRACT - Previous studies have suggested that children in areas with high air pollution levels have a high prevalence of respiratory disease. The aim of our study is:

1) To compare the prevalence of children's respiratory disease in a large number of geographical areas in which smoke and sulphur dioxide are being measured.

2) To relate any changes in the pattern of respiratory disease over successive years to changes in air pollution levels which may arise, for example from the introduction of smokeless zones.

The study started in 1973 and will last for 4 years. It is being carried out in 28 randomly selected areas in England and Scotland. About 10.000 children aged between 5 and 11 years are examined annually and their peak expiratory flow rate, height and weight measured. Parents are asked to fill in a questionnaire on each child's respiratory symptoms and disease episodes and the social and economic status of the family. The study design includes all children attending each school in the study. In subsequent years children attending school for the first time, at age 5 years, will be added while 11 year olds leaving primary school will leave the study. This design allows for comparison of equivalent age groups in successive years as well as cohort studies.

Since most children live close to their school, environmental smoke and sulphur dioxide is measured using a meter sited within 1 kilometre of the school.

This paper will present results obtained in the first year of the study.

EPIDEMIOLOGIC STUDIES OF ADVERSE HEALTH EFFECTS ASSOCIATED WITH EXPOSURE TO AIR POLLUTION

GORY J. LOVE

EPA, National Environmental Research Center, N.C., U.S.A.

ABSTRACT - The Human Studies Laboratory of the U.S. Environmental Protection Agency conducts a continuing program of epidemiologic studies in selected communities.(1) The careful selection of the communities permits measurements of particular health indicators in populations exposed to various levels of pollution. By controlling or analyzing for the significant cofactors, differences in the incidence of the health indicators are attributed to the differences in pollution levels to which the populations are exposed.

Studies are established in areas with higher than usual atmospheric levels of SO_2, NO_2, O_3 and suspended particulates. Particulates are studied on the basis of total quantity (TSP) plus the quantities of respirable particulates (RSP), suspended sulfates (SS) and suspended nitrates (SN). The health indicators measured in the populations include chronic respiratory disease (CRD), acute respiratory disease (ARD), pulmonary function (PFT) and the aggravation of cardiac or respiratory symptoms in individuals with predisposing illness.

All studies are coordinated with the clinical and toxicological studies conducted by other branches of the Human Studies Laboratory. (2)

The primary mission of the epidemiologic program in concert with that of the other branches is to provide the health information necessary for the establishment of reasonable air quality standards. In response to this mission the objectives of the epidemiologic investigations are:

1. To determine the substances for which air quality standards are desirable
2. To provide information relating to the levels at which the standards should be established
3. To evaluate the adequacy of established standards
4. To quantitate human pollutant burdens.
5. To document the health benefits derived from air pollution control.

Each objective is pursued by conducting dose-response studies.

Major accomplishments to date include the development of significant data relevant to the U.S. national primary ambient air quality standards and recognition of early benefits of air pollution control.

./.

Major problems faced by the program include the need for more information on the relationship between the physical and chemical properties of suspended particulate matter and toxicity; the significance of long-term mean exposure to pollutants as opposed to the repeated exposure to short-term peak levels; and the relationships of actual pollution exposure to that measured at index monitoring stations.

(1) Designed to document the adverse effects on human health associated with higher levels of air pollution.

(2) These all complement the field investigations by developing new methods and techniques for measuring adverse effects of exposure and by validating associations indicated by the field observations.

PREDICTIVE MODELS FOR ESTIMATING THE HEALTH IMPACT OF FUTURE ENERGY SOURCES

BERTRAM W. CARNOW

University of Illinois - USA

ABSTRACT - Decisions regarding future energy usage will depend on a number of major parameters, including those most essential to life, and must be based on consideration of the pollutants produced by the source, control methods for the pollutants, and, most important, the health effects produced by the energy source used.

Models for quantitating health effects on varying populations and the predictive capacity for assessing these effects have been developed and will be discussed; and, the types of studies that are needed to increase the required data base for this predictive capacity will be explored.

Results of a study examining visits to the emergency rooms in eighteen major hospitals in the City of Chicago during twenty-four hours on the same day of the week that was carried out for a period of eighteen months will be presented. Documentation of all admissions to the emergency rooms for cardiac, respiratory, and other diseases was maintained and levels of various air pollutants at the hospital and in the area of the residence from which the patients came to the hospital were evaluated. The study examines these relationships and their effect on the cardiopulmonary system and how these results can be used in the predictive model being developed. The model is based on the concept of a continual dose-response relationship between air pollutants and health and requires definition of various categories in the population at high risk. By quantitative definition of differences in disease at low and high pollution levels in those at high risk and determination of the total numbers of these individuals in the population, the numbers that are affected at varying levels of pollution can be ascertained.

L'EVALUATION DU RISQUE POUR LA SANTE DE LA POPULATION EXPOSEE AUX POLLUANTS ATMOSPHERIQUES IRRITANTS. ASPECTS METHODOLOGIQUES

B. BARHAD, M. CUCU

Institut d'Hygiène et de la Santé Publique - Bucarest -Roumanie

---

RESUME - Des amples recherches épidémiologiques effectuées dans des localités à atmosphère polluée par des agents irritants, représentés surtout par des suspensions métoxiques comme polluants majeurs et par le bioxyde de soufre et le bioxyde d'azote comme polluants secondaires, nous ont permis l'estimation de la sensibilité de certaines méthodes appliquées dans les études sur la population. Les zones étudiées n'étaient pas soumises à une pollution excessive, fait démontré par l'enregistrement continuel des principaux polluants.

Dans ces conditions, les études de corrélation statistique se sont avérées moins sensibles en ce qui concerne l'effet de la pollution de l'air sur la santé de la population, vis-à-vis des études de comparaison statistique, par rapport à une population témoin d'une zone faiblement polluée, en respectant évidemment avec rigueur toutes les conditions de sélection correcte des échantillons. Aussi bien, pour les conditions respectives, l'analyse de la morbidité et de la mortalité de la population en général n'a pas réussi à mettre en évidence des effets notables sur la santé, le phénomène étant reflété par l'investigation de l'état de santé de certains groupes de la population à sensibilité augmentée envers l'action des polluants atmosphériques.

Dans le cas de l'exposition aux polluants irritants mentionnés on a obtenu la mise en évidence de l'influence sur la santé tant de la population adulte que de la population infantile.

La population adulte la plus sensible s'est avérée le groupe entre 40-60 ans, où on a pu mettre en évidence une fréquence accrue des bronchopathies chroniques non spécifiques et des symptômes respiratoires. Afin de mettre en évidence les malades et les symptomatiques, on a utilisé le questionnaire proposé par le Medical Research Council, avec des menues modifications, et l'investigation de la fonction respiratoire à l'aide de l'expirographe Goddard. L'investigation de la fonction respiratoire après l'application des bronchodilatateurs, augmente la sensibilité de la méthode. La méthode s'est avérée adéquate à l'étude, mais elle porte l'empreinte des difficultés techniques (l'individu intervient, le rendement bas de l'examination spirographique), fait qui rend difficile la poursuite de grands groupes. Pour mieux mettre en évidence le phénomène, il est très utile de reprendre la recherche sur les mêmes groupes, comme le montrent les résultats obtenus.

En ce qui concerne les études sur la population infantile, le groupe le plus sensible s'est avéré celui compris entre 8-11 ans, d'où on obtient une bonne coopération et on évite le risque de l'habitude de fumer comme facteur interférant. Des méthodes pour la mise en évidence de

./.

l'existence de l'influence de la pollution de l'air sur la santé des enfants, des résultats concluants ont été obtenus par l'étude de l'absentéisme scolaire, de la fréquence des maladies et des symptomes respiratoires et - en partie - des modifications hématologiques.

L'absentéisme scolaire et ses causes ont été étudiés sur la base d'une fiche remplie par les cadres didactiques de l'école. L'analyse statistique a permis l'évaluation de la fréquence et de la gravité des maladies respiratoires.

La fréquence des maladies et des symptômes respiratoires a été étudiée à l'aide d'un questionnaire rempli par les parents et à l'aide de l'examen de la fonction respiratoire chez les enfants des groupes étudiés. Pour remplir le questionnaire on a utilisé la méthode de l'interview en groupe (20-30 parents), qui s'est avérée supérieure à l'interview individuel ou à la méthode de l'autoadministration du questionnaire. En ce qui concerne la fonction respiratoire, on a obtenu des résultats concluants tant par l'utilisation du peakflowmètre Wright, que par l'utilisation du vitalographe.

Des tests hématologiques utilisés, plus sensibles se sont avérés: la charge en hémoglobine des hématies, la fréquence des glandes lymphocytes et - en partie - la présence des corps toxiques.

Nous considérons que l'étude épidémiologique des groupes de population à sensibilité accrue permet l'évaluation des effets de la pollution de l'air sur la santé, même dans des conditions où le niveau de la pollution n'atteint pas de valeurs excessives.

EVALUATING THE RISKS FOR THE HEALTH OF THE POPULATION EXPOSED TO IRRITANT ATMOSPHERIC POLLUTANTS. METHODOLOGICAL ASPECTS

B. BARHAD, M. CUCU

Institute of Hygiene and Public Health, Bucarest, Rumania

ABSTRACT- Extensive epidemiological research has been carried out in localities where the atmosphere is polluted by irritants. In particular major pollutants have been studied in the form of methoxyl solutions. Sulphur dioxide and nitrogen dioxide have been studied as secondary pollutants. These have enabled us to estimate the sensitivity of certain methods applied to studies of the population. The areas studied were not subject to excessive pollution, as was shown by continuous recording of the main pollutants.

Under these conditions, statistical correlation studies proved the less effective method of demonstrating the effects of air pollution on the health of the population. Better results were obtained from statistical studies, comparing findings with results obtained from a reference sample of the population in an area that was not seriously polluted, adhering strictly, of course, to all the conditions for correct selection of samples. Moreover, under these conditions, an analysis of the morbidity and mortality of the population in general did not reveal any notable effects on health, a point which was also reflected in our investigations on the state of health of certain groups of the population unusually sensitive to the effects of atmospheric pollutants.

In the case of exposure to the irritant pollutants mentioned, the effects on the health of the adult population and the child population were clearly demonstrated. The most sensitive sector of the adult population proved to be the group aged from 40 to 60 years, in which it was shown that non-specific chronic bronchopathies and respiratory symptoms occurred with increased frequency.
The Medical Research Council's suggested questionnaire, with slight modifications, was used to collect details of patients and symptoms The respiratory function was investigated using a Goddard exhalograph. The sensitivity of this method increased when the respiratory function was examined after the use of bronchodilators. The method proved adequate for these studies, but was hampered by technical difficulties (the individual interrupts and the exhalographic examination has a low efficiency rate), and this makes it difficult to follow up large groups. As the results show, the facts are better demonstrated, when the research is repeated on the same groups.

As far as studies on the child population were concerned, the most sensitive group proved to be that from 8 to 11 years, which cooperated well in our studies, one point being that there was no risk that the smoking habit would be an interference factor. From the methods used to demonstrate that air pollution did indeed have an effect on child health conclusive results were obtained from studying

./.

absenteeism from school regarding the frequency of illnesses and respiratory symptoms, and, in part, haematological absence from school and its causes were studied using a form completed by the schools teaching authorities. A statistical analysis was used to evaluate the frequency and seriousness of respiratory illnesses.

The frequency of the illnesses and respiratory symptoms was studied using a questionnaire filled in by the parents and by examining the respiratory function in the children of the groups studied. The group interview method (20 to 30 parents) was used for completing the questionnaire. This proved better than individual interviews or having the parents themselves fill in the questionnaire. As far as the respiratory function was concerned, conclusive results were obtained, both when using the Wright peak flow meter, and a "vitalograph".

Of the haemotological tests used, the most sensitive proved to be the quantity of haemoglobin in the erythrocytes, the frequency of large lymphocytes and - in part - the presence of toxic bodies.

We consider that this epidemiological study of highly sensitive population groups enabled us to evaluate the effects of air pollution on health, even in conditions where the pollution level is not excessive.

STUDY ON LONG-TERM EFFECTS ON HEALTH OF AIR POLLUTION

*J. KUMPF, *M. ARHIRII, **B. GRAB, *M.J. SUESS

* World Health Organization, Regional Office for Europe, Copenhagen, Denmark,
** World Health Organization, Division of Health Statistics, Headquarters, Geneva, Switzerland

---

ABSTRACT - Epidemiological studies are required in order to ascertain the long-term effects on health of exposure to relatively moderate levels of pollution of ambient air.

To avoid the influence of other factors, such as occupational exposure and smoking, studies on children have been recommended.

School children, 8 - 10 years old, living in areas with different levels of air pollution, divided into "highly polluted" (annual median concentration of SO_2 more than 100 $\mu g/m^3$ and annual median concentration of standard smoke over 40 $\mu g/m^3$) and "low polluted" (SO_2 below 50 $\mu g/m^3$; standard smoke below 30 $\mu g/m^3$), are investigated by means of a questionnaire filled in by parents or guardians, and by means of lung function tests (Peak Flow Rate, FEV 0.75 and FVC).

Using a common working protocol and reporting forms, studies are currently carried out in five European countries. The results obtained in 1972 and 1973 studies will be analysed by a Working Group to meet in Düsseldorf in April 1974.

24

RELATION BETWEEN AIRCRAFT NOISE EXPOSURE AND HUMAN REACTION - A BIOLOGICAL MODEL

RAGNAR RYLANDER, STEFAN SORENSEN

Institut de Médecine Sociale et Préventive -
Genève, Switzerland

ABSTRACT - Noise exposure is a combination of several physical factors. The number of exposures, their duration, the frequency spectrum and the rise time of the energy front are some of the more important physical characteristics. It has been shown in laboratory as well as field experiments, that several of these are important for the development of an exposure reaction in humans. One has thus tried to include the relevant characteristics in various indices to express the noise exposure. Concerning community noises, these are usually constructed according to the acoustical principle of equal energy and contain expressions for the number of exposures as well as some mean of the noise level.

The background of such indices is mainly technical and only a limited number of studies deal with the biological relevance of the principles.

Concerning aircraft noise a relatively good correlation has been demonstrated between different indices based on the equal energy principle and the extension of annoyance in exposed communities. In several of the studies however, the development of the index has been performed against the background of available experimental data and weighting factors for various components of the index have been inserted by adapting the index to the already existing response pattern.

A different approach concerning the noise exposure was taken in a Scandinavian investigation concerning aircraft noise annoyance performed 1969-1972. In this investigation the number of aircraft movements and the noise level in dB(A) were kept separate and studied as independent variables.

The results from this investigation indicated that the exposure frequency is of importance to classify the areas in different exposure categories. A maximum was found at about 50 exposures/ 24 hours.

Within each exposure category the extent of annoyance was closely related to the dB(A) level from the noisiest aircraft using the airfield.

./.

The paper will report results from the re-analysis of other investigations, where a comparison was made between the new principles and the traditional noise exposure indices.

The practical applicability of the new principles will be reviewed and the possible implications for the new hypothesis concerning other environmental noises will be discussed.

TECHNIQUES FOR ASSESSMENT OF INDIVIDUAL SOUND EXPOSURE

LOUIS C. SUTHERLAND, MARCIA BRADEN, RICHARD COLMAN

Wyle Laboratories, 128 Maryland Street, El Segundo, California 90245 USA

ABSTRACT - Objective and subjective methodologies were developed in a feasibility study to assess sound exposure of a person as he went about his usual daily activities. For the objective method, A-weighted sound levels at the ear and two physiological parameters, heart rate and peripheral vasoconstriction at the ear lobe were monitored continuously on four subjects during their normal activity for one day. The instrumentation consisted of a small, portable package consisting of:(1) a subminiature electret microphone worn on the ear, (2) standard EKG chest leads for measuring heart rate, (3) a photoplethysmograph sensor mounted on the ear lobe for measuring peripheral vasoconstriction, and (4) signal-conditioning electronics connected to a small four-channel very low speed cassette tape recorder. Each of the four persons who participated in the experiment were instrumented early in the morning, wore the instrumentation for the entire day, and removed it at night. Each person also kept a log of location and activity during the day.

For the subjective part of the study, the components of human reaction to sound which have been studied extensively in the laboratory were evaluated in the real world by a questionnaire survey. This paper describes the application of one novel element of this questionnaire never before applied in this context. This consisted of a 24-hour diary using recall to probe for subjective impressions of dominant sounds for the previous 24 hours of 100 subjects. Subjective ratings for a number of physical and psychological parameters of each of the hourly dominant sounds were also solicited. This provided a wealth of data on subjective response to sound on a time frame not generally available.

Results from this pilot test of these objective and subjective measurement techniques are presented to illustrate their interrelationship and usefulness for evaluation of overall sound exposure of individuals. Particular emphasis is placed on the ability of these techniques to properly assess the relative exposure and reaction of individuals to outdoor versus indoor or human sources of sound exposure. This study was sponsored jointly by the Department of Transportation and Environmental Protection Agency, USA.

SLEEP DISRUPTION BY AUDITORY NOISE AND ITS EFFECT ON WAKING PERFORMANCE

T.E. LEVERE

Neuropsychology Laboratory, North Carolina State University, U.S.A.

ABSTRACT - The research interests of our laboratory over the past four years have addressed 3 major questions. Firstly, is it possible to predict an individual's response to auditory noise during sleep on the basis of how this individual responds to auditory stimuli during wakefulness? Secondly, is waking behavior effected when sleep is disturbed by auditory noise? And thirdly, if sleep disruption does influence waking behavior, what are the important parameters of this sleep disruption which produce the effects on waking behavior? Our experimental data indicate that the first two questions have relatively straightforward answers with the answer to the first question being no and the answer to the second question being yes. That is, how an individual responds to auditory stimuli when awake, does not predict how this individual will be aroused by these same stimuli during sleep. Specifically, the classic laws of psychophysics relating sound pressure level, auditory frequency, and psychological loudness during wakefulness are not applicable during sleep. Considering the carry-over effects of nocturnal auditory stimulation to waking performance, the results of our researches suggest that even minimal sleep disruption by auditory noise can be detrimental to certain waking behaviors. On the basis of our experimentation and other related research, it would appear that the behaviors most susceptible to this sleep disruption are those behaviors involving higher cognitive processes particularly memory functions. Turning to the parameters of sleep disruption which may produce these waking behavioral effects, our data firstly indicate that in absolute quantity, the nocturnal stimulation need not be extensive. In certain instances, no more than 9 15-second presentations of broad band auditory noise at a level of 80 db(A) spread over a night's sleep can significantly disrupt an individual's performance of a short-term memory reaction-time task performed shortly after the subject awakes in the morning. Additionally, other of our research indicates that these morning performance deficits are more closely related to the total arousal which occurs during the night in response to the auditory noise and not necessarily the degree of arousal produced by the stimulus presentations *per se*. Finally, certain preliminary data suggest that the disruption of certain types of sleep by auditory noise, particularly sleep characterized by slow-wave electroencephalographic activity, may be more detrimental to waking performance than auditory noise occurring during sleep characterized by

other types of electroencephalographic activity. Considered together these data, along with other researches, tend to suggest that sleep is a qualitatively unique behavioral state necessary to an individual's well-being. And, should the normal functioning of this behavioral state be interfered with by auditory stimulation, even minimally interfered with, it is possible that optimal waking behavior may suffer. These results thus not only reflect certain fundamental aspects of sleep but also provide empirical support for the commonly held, but mostly subjective. consensus that sleep disruption is one of the most serious problems of noise pollution.

IMPACT OF ENVIRONMENTAL NOISE ON SLEEP ELECTROPHYSIOLOGY AS MEASURED IN THE HOME

JOYCE FRIEDMANN, GORDON GLOBUS, HARRY COHEN

University of California, Department of Psychiatry, U.S.A.

ABSTRACT - In considering the effects of environmental noise on sleep, there are a number of limitations to laboratory studies. For example, the generalizability of results from laboratory studies is problematic, since habituation to long term noise exposure is not present in acute laboratory studies. For these reasons, we have developed electrophysiological and acoustic home recording capability. Our system provides a portable economical package of frequency modulated design subcarrier oscillator which can be left unattended. Electroencephalographic and electrooculographic signals, as well as, environmental acoustics signals can be telemetered or stored on a tape recorder, to be written out at the experimenter's convenience. This system has been easily tolerated by subjects.

We have applied this system to the study of aircraft flyover noise on sleep directly beneath the flight pattern at Los Angeles International Airport. We have studied 11 couples for five consecutive nights in this naturally occurring environment, and further studied, for 15 additional nights four of these couples, at a time in which the noise level in their homes was dramatically decreased during sleeping hours. We have also accomplished long term studies on the effects of gradual sleep deprivation imposed by an environmental schedule. In these studies, we accumulated three recording nights per week on two couples over six months.

Utilizing this technology, we have found, for example, that there is more "light sleep" in noisy areas compared to control areas, and that when the noise was lessened, the amount of "light sleep" decreased. "Deep sleep" was decreased in the noise condition, and also increased following the transition to a quieter environment. Subjective ratings of fatigue, lack of vigor and tension were diminished in the quieter environment.

Pressing environmental questions as to the public health hazards posed by chronic noise exposure during sleeping hours in naturally occurring environments, can now be assessed in a rigorous and objective manner utilizing a reliable home recording system.

LAERMBEDINGTE VEGETATIVE REAKTIONEN IN ABHAENGIGKEIT VON ALTER, GESCHLECHT, UMGEBUNGSGERAEUSCH UND NACH VERABREICHUNG EINER DURCHBLUTUNGSFOERDERNDEN SUBSTANZ

G. JANSEN, E. DAMS

Universitätsklinikum, Essen, B.R. Deutschland

ABSTRACT - Es wurden die Reaktionen von 24 Menschen bei Schallreizen (Breitbandgeräusch) von 105 dB(A) untersucht. Als Parameter wurden bestimmt: periphere Blutvolumenregulation, Pulsfrequenz, Atemfrequenz und zeitweilige Hörschwellenabwanderung (TTS). Die Versuchspersonen wurden nach Alter und Geschlecht hinsichtlich der Lärmreaktionen verglichen. Sodann wurden die Versuche bei niedrigem (40 dB(A) und bei hohem (70 dB(A) Umgebungspegel geprüft. Weiterhin wurde die unterschiedliche Kompensation der Lärmwirkung durch eine durchblutungsfördernde Substanz (Xantinolnicotinat) ermittelt; hierbei ergaben sich in Abhängigkeit von Alter, Geschlecht und Grundpegel unterschiedlich große Kompensationen. Diese Unterschiede zeigten sich vor allem beim Vergleich der peripheren Blutvolumenregulation mit der Hörschärfenminderung.

Die Bedeutung dieser Befunde für die Erstellung von Richtwerten wird diskutiert. Es wird auf die "Gesamtwirkung" des Lärms hingewiesen.

NOISE INDUCED VEGETATIVE REACTIONS DEPENDING FROM AGE, SEX, AMBIENT NOISE, AND FROM A VASOACTIVE DRUG

G. JANSEN AND E. DAMS

Institut für Hygiene und Arbeitsmedizin
Universitätsklinikum der Gesamthochschule Essen, B.R. Deutschland

ABSTRACT - 24 test subjects of different ages (12 males and 12 females) were exposed to noise of 105 dB(A) five times for 5 minutes each and intervals of 5 minutes between two noise periods. In the intervals there were ambient noise levels of 40 dB(A) and in another test series 70 dB(A). In addition we used in one half of the tests vasoactive drug (xantinol-nicotinacid = x.-n.). Peripheral blood circulation, pulse rate, breathing rate and temporary threshold shift were measured.

Our experiments resulted in different effects of noise in peripheral blood circulation and TTS, whereas no influence was observed concerning pulse rate and breathing rate. The results are discussed with respect to criteria and limits. It is recommended to look at the "whole reaction" of noise which may preferably occur in one of the following fields : otological, physiological and/or psychological reactions.

---

* Research financially supported by the Government of the Federal Republic of Germany (Bundesministerium des Innern)

ANIMAL MODELS FOR HUMAN DISEASE

D.E. GARDNER

Pathobiology Research Branch, Experimental Biology Laboratory,
Research Triangle Park - North Carolina - U.S.A.

ABSTRACT - Epidemiology and animal toxicology together yield health effects data which provide the guidelines for formulation of reasonable air quality standards. Epidemiologic studies suggest human health effects of pollutants in the ambient air. Community studies must cope with a host of complex covariates, are restricted to a limited range of exposures, and often provide information too late for preventive measures. Toxicology studies provide the opportunity to control some covariates, to utilize a wide range of pollutant exposures, to isolate the effects of individual pollutants, and to predict potential hazards. These two disciplines complement one another in providing information suggesting the possibility of cause and effect relationship which can then be used to set standards. This session will be directed toward the description, characterization, and evaluation of currently available whole animal models which have been or could be used as a biological indicator of adverse human health effects.

Diseases of the lung constitute a major world wide health problem of increasing dimensions. Epidemiological studies have shown that there is more than a casual relationship between air pollution and respiratory disease. It is no longer necessary to speculate about the cause-effect relationship between air pollution and increased susceptibility to infection, alteration in pulmonary function and ultrastructural pulmonary changes. There is agreement between several animal models and epidemiologic observations that illustrate such a correlation. In addition, animal models have duplicated adverse health effects observed in the human population such as cancer; and have confirmed the interaction of temperature, exercise, and air pollutants.

Considerable effort has been devoted to the development of new sensitive, valid, indicators of the deterioration in health caused by environmental pollutants. Most of these models have not yet been applied to epidemiological studies. These include, the impairment of cellular and immunological defense mechanisms, acceleration of aging, chromosome damage, edema production, acceleration of atherosclerosis, and effect of pollutants on cardiac and renal tissue.

It is known that within the general population there are certain high-risk individuals, for example, those with coronary heart disease, chronic bronchitis, emphysema, and asthma, who would be predisposed to the adverse effects of air pollutants. Some of these diseases either appear spontaneously in selected animal species or may be induced, but few have been exploited adequately. Obviously, these animal models offer many advantages in controlled studies of the interaction of environmental factors, and the pathogenesis of the disease.

./.

New technological innovations often produce a change in type and quantity of pollutants. A variety of new substances could be produced and distributed into the environment before their effects on health are fully known. It is only through close cooperation between human and animal studies that environmental science can keep abreast of this rapidly changing challenge to our environment.

DIE TUMORERZEUGENDE WIRKUNG INHALIERBARER FASERFOERMIGER STAEUBE

F. POTT, K.H. FRIEDRICHS, F. HUTH

Medizinisches Institut für Lufthygiene und Silikoseforschung an der
Universität Düsseldorf, B.R.D.

KURZFASSUNG - Unter den inhalierbaren faserförmigen Stäuben nahm der Asbest bislang wegen seiner vielseitigen Verwendung in den verschiedensten industriellen Bereichen eine Sonderstellung ein. Seit etwa zehn Jahren werden aber ausserdem in zunehmendem Masse Glas- und Gesteinsfasern hergestellt, die einen Durchmesser von weniger als 5 µm haben und daher bis in die Lungenalveolen eindringen können. Die seit über 30 Jahren bekannte tumorerzeugende Eigenschaft von Asbestfasern wirkt sich bei Asbestfasern erst 20 - 40 Jahre nach Beginn der Asbestexposition aus. Daher wird es erst ab 1985 möglich werden, aufgrund von epidemiologischen Studien Aussagen über eine eventuell vermehrte Tumorerzeugung von Glas- und Gesteinsfasern beim Menschen zu machen. Vorläufig sind wir zu dieser Frage auf Ergebnisse aus tierexperimentellen Untersuchungen angewiesen.

Nach intraperitonealer Injektion von 100 mg verschiedener faserförmiger Stäube (Chrysotil-Asbest, Krokydolith-Asbest, Palygorskit, Nemalith und Glasfasern) entstanden bei Ratten in hohem Prozentsatz maligne Tumoren, die vorwiegend als sarkomatöse Mesotheliome diagnostiziert wurden. Hauptsächlich körnige Stäube (Aktinolith, Biotit, Pektolit, Talk), die dem Chrysotil-Asbest chemisch nahe stehen, führten demgegenüber nicht oder nur in Einzelfällen zu Tumoren. Weitere, z.Zt. noch nicht abgeschlossene Experimente mit kleineren Staubmengen zeigten, dass 2 mg Chrysotil, Krokydolith oder Glasfasern zu Tumoren führen können. Dabei wurden Glasfasern verschiedener Hersteller verwendet.

Aus diesen Befunden wird geschlossen, dass die Wirkung von Asbest an die Faserform gebunden ist und nicht an seine chemische Zusammensetzung. Daher ist die Faserzahl das Kriterium für die applizierte Dosis, nicht das Gewicht. Die Untersuchungen ergeben darüber hinaus, dass Faserdurchmesser und Faserlänge für die Wirkung von Bedeutung sind. Die Prüfung der Dosis-Wirkungsbeziehungen wird durch die Abhängigkeit von den genannten 3 Faktoren sehr erschwert. Komplizierend ist ausserdem, dass Durchmesser und Länge von Faserstäuben stark variieren.

Aufgrund experimenteller Untersuchungen und weiterer Berechnungen werden annähernde Aussagen darüber gemacht, welche Mindest- und Höchstmasse von Länge und Durchmesser vorliegen müssen, damit eine Faser bei der Ratte Tumoren induzieren kann. Die Uebertragbarkeit der Ergebnisse auf den Menschen wird diskutiert. Ausserdem wird zu der Frage Stellung genommen, inwieweit andere inhalierbare Fasern ausser Asbest von Menschen am Arbeitsplatz und in der freien Atmosphäre inhaliert werden können.

THE TUMORIGENIC EFFECT OF INHALABLE FIBROUS DUSTS

F. POTT, K.H. FRIEDRICHS, F. HUTH

Medizinisches Institut für Lufthygiene und Silikoseforschung,
Universität Düsseldorf, Federal Republic of Germany

ABSTRACT - Asbestos has hitherto occupied a special place among inhalable fibrous dusts because of its use in a great variety of industrial fields. In the last ten years or so, however, there has been increasing production of glass fibers and rock wools, which have a diameter of less than 5 /um and can therefore penetrate the pulmonary alveoli. The tumorigenic properties of asbestos fibres, which have been known for more than thirty years, do not take effect until twenty to forty years from the beginning of exposure. It will not therefore be possible to make any statements on the tumorigenic effects of glass figres and rock wools in human beings on the basis of epidemiological studies until 1985. Until then we are dependent on results from experiments on animals.

After intraperitoneal injection of 100 mg. of various fibrous dusts (chrysotile-asbestos, crocidolite-asbestos, palygorskite, nemalite and glass fibres), malignant tumors, which were diagnosed predominantly as sarcomatous mesothelomias, occurred in a high percentage of rats tested. Mainly granular dusts (actinolite, biotite, pectolite, talc), which are chemically related to chrysotile-asbestos, did not on the other hand cause tumors, or caused them only in isolated cases. Further experiments with smaller amounts of dust, which have not yet been completed, showed that 2 mg. of chrysotile, crocidolite or glass fibres can lead to tumors. Glass fibres produced by various manufacturers were used.

It is concluded from these findings that the effect of asbestos is related to its fibrous form and not its chemical composition. Thus the number of fibres is the criteria for the dose applied, not the weight. Experiments further proved that fibre diameter and length are of importance for the effects. Testing of the dose-effect relationship is greatly complicated by the three factors mentioned, and also by the great variations occurring in the diameter and length of fibrous dusts.

On the grounds of experimental findings and further calculations, approximate predictions are made as to the minimum and maximum fibre lengths and diameters which can induce tumors in rats. The applicability of the results to human beings is discussed. An assessment is also made of the extent to which inhalable fibres other than asbestos are inhaled by human beings at their place of employment or in the open air.

TERATOGENIC, MUTAGENIC, AND CARCINOGENIC EFFECTS OF INSECTICIDES

LAWRENCE FISHBEIN

National Center for Toxicological Research
Jefferson, Arkansas 72079 - U.S.A.

ABSTRACT - There is increasing concern over the possible toxicological hazards posed by a spectrum of environmental chemicals including industrial pollutants, pesticides, food additives, and drugs,either considered singley as a class or specific agent or in combination. A number of insecticides, based on aspects of their ubiquity, persistence, presence, and/or concentration in the food chain as well as their biological and toxicological properties, constitute a major source of potential environmental hazard to mammal species including man.

However, there exists considerable disagreement concerning the scientific assessment of effects (notably teratogenic, mutagenic and carcinogenic) of these agents, primarily because of the variety of testing procedures employed within the three major areas of toxicity, hence complicating comparisons within any one area; complexity of unambiguous recognition and interpretation of the toxic event and finally the extrapolation and relevance of experimental laboratory findings to man.

To permit a more orderly assessment of the above effects the possible interrelationships between teratogenicity, mutagenicity, and carcinogenicity will be cited as well as the most salient features of the respective testing procedures employed with concomittant clarification of their principles, problems, and interpretations.

The teratogenic, mutagenic, and carcinogenic insecticides that will be discussed include the following:

chlorinated hydrocarbons (DDT and metabolites); cyclodienes (dieldrin, aldrin, and endrin); miscellaneous chlorinated insecticides (benzene hexachloride and Mirex); organo-phosphorus derivatives (dichlorvos (DDVP), trichlorphon, malathion, parathion, and methyl parathion) and carbamates (carbaryl).

TOXICOLOGY OF ATMOSPHERIC POLLUTANTS RESULTING FROM FUEL ADDITIVES AND EMISSIONS ASSOCIATED WITH THE USE OF AUTOMOBILE CATALYTIC CONVERTERS

J.F. STARA, W. MOORE, A.W. BREIDENBACH

EPA - National Environmental Research Center - Cincinnati, Ohio, U.S.A.

ABSTRACT - United States automobile manufacturers developed plans to use catalytic converter for controlling exhaust emissions of carbon monoxide and hydrocarbons in the 1975 models of light duty vehicles. However, emissions from the oxidation catalysts control devices are thought to increase the ambient air concentration of sulfates and other SOx products in areas of high traffic; they may also introduce new atmospheric pollutants into the environment such as the noble metals palladium and platinum.

The Environmental Toxicology Research Laboratory (ETRL), of the U.S. Environmental Protection Agency's National Environmental Research Center in Cincinnati, Ohio, uses a definitive toxicologic matrix to investigate the biologic effects of the individual catalyst components and the whole exhaust emissions. The tests employ 1975 automobile engine prototypes (Ford and Chevrolet) equipped either with or without a noble metal pelletized oxidation catalytic converter. In the reported series of experiments, the operating conditions for the engine were the same for each exposure. Part of the exhaust was passed through specially designed irradiation chambers for exposure to simulated sunlight (for production of photochemical products) before being introduced into the animal exposure chambers; the remaining emissions were conducted to other chambers without further treatment except dilution by conditioned air. Comparison of carbon monoxide and total hydrocarbon levels in the catalyst treated and nontreated exhaust revealed that concentrations of both gases were reduced by 85% due to catalytic reaction. The levels of nitrogen oxide were nearly similar except for a lower concentration in the irradiated nontreated exhaust.

The toxicological matrix employs a number of scientific disciplines, such as biochemistry; pathology; cardiovascular-, pulmonary- and CNS- physiology; teratology; kinetics and metabolism; aerometry; chemistry; and engineering, to provide comprehensive physical and biological data for evaluation of the potential public health hazard of the emission components.

The research investigations are conducted in series of acute, subacute, and chronic studies. As an example of acute experiments, the toxic effects of several chemical forms of palladium and platinum are presented, together with data on metabolism and kinetics, ocular and dermal irritancy, neurophysiological changes, and pathological manifestations in tissues. The subacute studies are designed to determine specific biological effects on the whole organism and on sensitive organs and tissue systems using lower, more realistic exposure levels. These studies may have a duration of several days to a month or longer, and they constitute the major portion of the ETRL toxicologic program. In this paper, the bio-effects of automobile emissions, with and without catalytic converters, on rats and hamsters are presented. Measured parameters included infant mortality, body weight changes in sucklings and their mothers, systematic changes in young

./.

adults, and evaluation of changes in the cellular and acellular components of blood in adult males. Additional investigations in progress include chronic inhalation studies of the noble metal compounds, sulfates, and whole catalyst emissions.

To comply with emission standards, the automotive industry in the United States continues to introduce new fuels, fuel additives, and control devices. The WTRL provides necessary background for health intelligence, specifically toxic effects data required as a guide in making regulatory decisions concerning pollution of the environment from mobile and stationary sources. The current research provides needed information that is largely unavailable from other sources.

QUANTITATIVE ESTIMATION OF THE EFFECT OF VARIOUS PULMONARY IRRITANTS ON THE LUNG CELL POPULATION

M. GRUENSPAN

Medizinisches Institut für Lufthygiene und Silikoseforschung
an der Universität Düsseldorf
F.R. Germany

ABSTRACT - The R.E.S. is represented by cells having the capacity to phagocytose foreign particulate matter.

This activity is accomplished by 2 categories of cells:

a) the fixed R.E. cells in the liver, spleen, bone marrow, lungs etc.

b) the free R.E. cells distributed in the circulation and by this way reaching various organs, especially the lungs.

Both cell categories are called macrophages, and those which are located in the lungs, alveolar macrophages. Their special function is the immunologic and homoeostatic defence of the lung.

Certainly a reaction takes place between alveolar macrophages and pulmonary irritants entering the lungs; but these morphological, biochemical and immunological events are not clearly understood.
As part of an organ which comes first in contact with atmospheric pollutants and other pulmonary irritants, the alveolar macrophages play an important role in lung defence, which is accomplished by a certain number of alveolar macrophages. It is a still unresolved problem whether this defence is executed by an invariable amount of macrophages or if various pulmonary irritants can increase or diminish the number of alveolar macrophages in the lungs. The physiological and pathological mechanisms which elicit the increase or diminuation of the alveolar macrophages are incompletely investigated, too. We suppose that because the lung macrophages are part of the general R.E.S., any augmentation of lung macrophages suppose that supply is a secondary one inasmuch as the cells are furnished to the lung from the R.E. organs as a response to pulmonary injury. Another possibility is the autonomous pulmonary response i.e. diminution or augmentation occur by multiplication of alveolar macrophages in situ.

The number of alveolar macrophages on the one hand probably depends from the chemical nature of the pulmonary irritant, its retention in the lung and the duration of the exposure, on the other hand from the age of the exposed being; all these relationships are in detail. In order to clarify this problem we have developed 2 methods to test the influence of various pulmonary irritants on the cell population of the lung.

The first method

Young and old rats were exposed to gaseous noxious agents that contaminate urban atmospheres, for seven days, 24 h per day. At different times the animals were killed and the lungs washed with saline. The alveolar

./.

macrophages were obtained from 23 lung washings per animal, using 1 ml of saline for each washing. The number of cells and the cell size (3 categories) was estimated with a Culter Counter, Model FN.

The second method

Rats were injected intraveneously with polyvinylpyridine-N-oxide (PVNO) a polymeric nontoxic substance which accumulates in the R.E.S. By means of a quantitative method, we have estimated the amount of PVNO stored in the liver, spleen, bone marrow, and lungs 2 months after the i.v. application of PVNO. The greatest amounts are found in the liver, spleen, and bone marrow; only small quantities of the polymer are found in the lung. Rats pretreated in this way were exposed to various gaseous noxious agents and to various substances injected intratracheally.

At different times after the beginning of the exposure the animals were killed, the lungs were homogenised and their content in PVNO estimated.

The amount of PVNO found in the lungs is a measure of the number of R.E. cells accumulated in the lungs as a direct consequence of the pulmonary injury caused by gaseous noxious agents or other substances damaging the alveoli.

Thus, the augmentation or diminution of the number of alveolar macrophages following exposure to various noxious agents can be quantified directly with the help of the Culter Counter or by measuring the PVNO content of Rat lung after labelling the cells with this nontoxic polymeric substance these estimations providing important insight into the defence of the lung because the alveolar macrophage is involved both into the phagocytosis of inhaled particles and into the production of antibodies.

The data given in this report have been gained by application of these two methods. They are concerning the in vivo effect of various concentrations of NO_2, SO_2, O_3, and other noxious agents present in the urban atmosphere, upon the number of lung macrophages and upon the factor which stimulates or inhibits the mobilisation and transport of macrophages from the organs of the R.E.S. to the lungs.

AN EXPERIMENTAL STUDY OF THE EFFECTS OF NOISE ON THE CENTRAL NERVOUS SYSTEM. MODIFICATIONS OF THE CEREBRAL ELECTRICAL ACTIVITY OF MICE FOLLOWING VARIOUS KINDS OF ACOUSTIC STIMULATIONS.

V. BARBARO, F. GARIBALDI, A. LOIZZO, M. NERONI, G. ZAPPONI

Laboratori di Elettronica e di Chimica Terapeutica,
Istituto Superiore di Sanità, via Regina Elena 299, Roma 00161, Italy.

ABSTRACT - One of the aspects of the environmental pollution is the effect of noise on the environment.

Experimentally it is possible to demonstrate several effects of noise on the central nervous system: *e.g.* by submitting animals (rats, mice) to sounds of particular characteristics and intensity convulsions can be elicited (audiogenic seizures).

In present investigations more sophisticated apparatuses allow us to evidence fine changes in cerebral electrical activity of freely moving mice, bearing chronically implanted electrodes, following acoustic stimulations of various intensity and duration. These changes can be modified by the administration of some psychotropic drugs.

UEBER LOKALE EFFEKTE INHALIERTER BLEIVERBINDUNGEN AUF DIE LUNGE

J. BRUCH, A. BROCKHAUS, W. DEHNEN

Medizinisches Institut für Lufthygiene und Silikoseforschung,
Düsseldorf, B.R. Deutschland

KURZFASSUNG - Um den Einfluß von bleihaltigen Stäuben auf die Lunge zu prüfen, wurden mehrere Inhalationsexperimente an verschiedenen Versuchstieren durchgeführt. Die erste Serie der Experimente sollte den Einfluß von feinen PbO-Partikeln auf die Lungenreinigungsfähigkeit testen. Ratten inhalierten täglich an 5 Tagen in der Woche morgens 5 h lang PbO und nachmittags 3 h TiO_2. Tiere, die nur TiO_2 inhaliert hatten und Reinlufttiere dienten als Kontrolle.

Die Versuche wurden in zwei Serien durchgeführt. Das erste Inhalationsexperiment dauerte 4 Monate, die mittlere PbO-Konzentration betrug 80 $\mu g/m^3$. Die Ratten wurden unmittelbar nach Ende der letzten Inhalation getötet. Das zweite Experiment dauerte 3 Monate bei einer mittleren PbO-Konzentration 160 $\mu g/m^3$ Luft. In diesem Falle wurde zwischen dem Inhalationsende und dem Tötungstermin ein Intervall von 7 Tagen eingeschoben. In beiden Versuchen ergab sich unter Bleiexposition eine deutlich verschlechterte bronchiale Elimination aus der Lunge und eine erhöhte lymphatische Penetration des Teststaubes TiO_2.

In einer ergänzenden Untersuchung wurde morphometrisch an histologischen Schnitten die Lungenveränderungen und die Zahl und Größe der Staubdepots quantitativ bestimmt.

Elektronenmikroskopisch ließen sich deutliche ultrastrukturelle Veränderungen an den Alveolarmakrophagen beobachten. Weiterhin wurde die Funktion der ausgewaschenen Alveolarmakrophagen mit verschiedenen biochemischen Testmethoden in vitro analysiert. Besonders interessant erscheint der Befund, daß die Fähigkeit der Zellen das Carcinogen 3.4-Benzo(a)pyren abzubauen durch das inhalierte Blei wesentlich inhibiert ist.

Zusätzliche autoradiographische und elektronenmikroskopische Untersuchungen sollten einen Einblick über den Einfluß des Bleis auf die Alveolarepithelzellen (Typ I und III) erbringen.

Auf Grund dieser Untersuchungen muß bei der Abschätzung oder Gefährdung des Menschen durch partikelförmige atembare Bleiverbindungen auch an lokale Effekte des Schwermetalls auf die Lunge gedacht werden.

(In Ergänzung zu den oben dargelegten Befunden soll auch über Infektionsversuche mit Parainfluenzavirus an der Maus unter Bleiexposition berichtet werden. Die Versuche werden im Frühjahr 1974 abgeschlossen.)

LOCAL EFFECTS OF INHALED LEAD COMPOUNDS ON THE LUNGS

J. BRUCH, A. BROCKHAUS AND W. DEHNEN

Medizinisches Institut für Lufthygiene und Silikoseforschung
Düsseldorf, Federal Republic of Germany

ABSTRACT - To examine the influence of lead-containing dusts on the lungs, a number of inhalation experiments were carried out on various laboratory animals. The first series of experiments was to test the influence of fine PbO-particles on the lungs' cleansing ability. Rats were made to inhale PbO every morning for five hours and TiO_2 every afternoon for three hours five days a week. Animals who were only inhaling TiO_2 and animals breathing clean air acted as controls.

The tests were carried out in two series. The first inhalation experiment lasted four months and the average PbO concentration was 80 micrograms/cbm. The rats were killed immediately after the last inhalation. The second experiment lasted three months, the average PbO concentration being 160 micrograms/cbm air. In this case, an interval of seven days was inserted between the end of the inhalation and the date of killing. In both tests exposure to lead was accompanied by clear deterioration of the bronchial elimination from the lungs and an increased lymphatic penetration of the test dust, TiO_2.

In a complementary investigation, the lung changes were determined morphometrically on histological sections and the number and size of the dust deposits were established.

Clear ultrastructural changes to the alveolar macrophages could be observed with the electron microscope. In addition the function of the alveolar macrophages which had been washed out, was analysed in vitro using different biochemical test methods.

The discovery that the ability of the cells to break down the carcinogen 3.4 benzo(a)pyrene is considerably inhibited by the inhaled lead seems particularly interesting.

Additional investigations with the autoradiograph and the electron microscope should give an indication of the influence of lead on the alveolar epithelium cells (types I and II).

On the basis of these investigations the local effect of heavy metal on the lungs must be taken into consideration when assessing the danger of exposing human beings to particulate inhalable lead compounds.

(Supplementary to the above findings a report is also to be presented on infection experiments with a para-influenza virus on mice exposed to lead. The experiments will be completed in the spring of 1974.)

LOW LEVEL LEAD TOXICITY

ALAN M. GOLDBERG AND ELLEN K. SILBERGELD

School of Hygiene and Public Health, Baltimore, Maryland, USA

ABSTRACT - Lead poisoning in children is associated with several serious pathological and behavioral deficits. Studies in adult animals have been unable to support the association between lead intoxication and behavioral dysfunction. However, when suckling mice are exposed to lead from birth they exhibit an increase in spontaneous motor activity. In this study, mice were exposed to lead acetate from birth indirectly through their mothers' milk and then directly after weaning in their drinking water. Concentrations of lead acetate in the drinking water of 5 mg/ml and as low as 2 mg/ml produced behavioral disorders. At this dose of lead no classical overt signs associated with lead toxicity were seen in either the offspring or the mothers. Cerebral edema and histopathology were not observed in any of the offspring. However, growth of the offspring was decreased 10%. Spontaneous motor activity was measured from 30 to 150 days of age. The lead intoxicated mice were more than three times as active as coetaneous controls. A number of drugs used in the treatment and diagnosis of minimal brain dysfunction hyperactivity (MBD) in children were tested in these animals. The compounds chosen either decrease the hyperactivity in children (amphetamines, methylphenidates and Deaner®) or, in the case of phenobarbital, exacerbate the symptomotology. In control animals in this study, these drugs acted in the expected manner. In the lead-intoxicated mice, these same compounds acted as they do in MBD hyperactivity. In order to understand the basic mechanisms underlying this lead-induced behavioral deficit, a combined pharmacological and neurochemical approach has been used. The data are supportive of a defect in the interactions of cholinergic and dopaminergic function. The model described has sufficient parallels to the clinical description of minimal brain dysfunction hyperactivity to make it a useful model to study the biochemical mechanisms in both lead toxicity as well as hyperactivity. Additionally, this study emphasizes the need for the administration of potentially toxic compounds during the critical stages of neurological development in order to assess the impact of these compounds in the human. This project was supported in part by the National Institutes of Environmental Health Sciences grants 00034 and 00454.

STUDIES OF LEAD ENCEPHALOPATHY IN THE DEVELOPING RAT

I. ARTHUR MICHAELSON, ROBERT GREENLAND AND M. W. SAUERHOFF

Department of Environmental Health, University of Cincinnati, Ohio, USA

ABSTRACT - Inorganic lead produces cerebral dysfunction and clinically definable encephalopathies in man. The expected sequelae of pediatric lead encephalopathy consist of altered behavioral patterns and learning disabilities. To date there have been few studies on the biochemical changes in brain following exposure to inorganic lead. Studies correlating toxicity to behavioral and brain neurochemical changes following lead exposure have been hindered because adult laboratory animals are resistant to the central nervous system effects of lead poisoning. Such studies have been impeded by lack of suitable experimental models until Pentschew and Garro (Acta Neuropath. 6:266, 1966) showed that brain lesions develop in neonatal rats when a pregnant rat newly delivered of her litter is placed on a four percent lead carbonate containing diet. Lead passes into the developing sucklings via maternal milk. Lead poisoned newborns have pronounced retardation of growth and during the fourth week of life develop the severe signs of lead encephalopathy, namely extensive histological lesions of the cerebellum, brain edema and paraplegia.

We have employed this experimental model to study both severe and mild forms of lead encephalopathy in the developing rat. In the former we have found a failure of cell multiplication in the cerebellum. However, in the latter we have found that during the fourth week of development young rats display hyperactivity, tremors and stereotype behavioral patterns. Pair-fed controls coetaneous to experimental groups do not display such activities. Estimation of brain serotonin, gama-amino-butyric acid, norepinephrine and dopamine suggests a disruption in catecholamine metabolism during the periods of altered behavior in lead exposed developing rats.

The experimental design as described provides a model of CNS dysfunction due to lead exposure without debilitating histopathologies. It is possible that our findings on increased motor activity and changes in brain monoamines may correspond to early responses to lead exposure before recognized overt signs of toxicity.

Supported by NINDS Grant NB-06053 and 1-F11-NS 2580-NSRB and NIEHS ES00042.

SUBCHRONISCHE ORALE TOXIZITAET VON CADMIUM BEI RATTE UND HUND

D. LORKE, E. LÖSER

Institut für Toxikologie, Wuppertal, B.R. Deutschland

KURZFASSUNG - Klammert man die gewerbetoxikologischen Probleme beim Kontakt mit Cadmium aus, so wird dieses Metall praktisch nur oral vom Menschen aufgenommen. Toxikologische Untersuchungen zur Feststellung der Gefährdung durch den Gebrauch von Cadmium-haltigen Gegenständen müßen daher mit oraler Verabreichung durchgeführt werden.

Die in der Literatur beschriebenen Untersuchungen sind entweder nicht mit oraler Applikation durchgeführt worden oder sie entsprechen nicht völlig dem neuesten Stand der Wissenschaft. Es ist deshalb notwendig, solche Versuche durchzuführen.

Zunächst untersuchten wir die subakute orale Toxizität (90-Tage-Test) für Ratte und Hund mit den folgenden Ergebnissen :

1. 3monatiger Fütterungsversuch an Ratten

   Je 20 männliche und 20 weibliche Ratten erhielten Cadmium (als $CdCl_2$) in Dosierungen von 1, 3, 10 bzw. 30 ppm 3 Monate lang mit dem Futter verabreicht. Als Kontrollen dienten 40 männliche und 40 weibliche Ratten.

   Bei den so behandelten Ratten waren Aussehen, Verhalten, Futteraufnahme, Wachstum und Sterblichkeit während der 3monatigen Versuchszeit nicht beeinflußt. Bei der 3monatigen Applikationsdauer ergaben sich keine Blutschädigungen.

   Die klinisch-chemischen Untersuchungen sowie die Sektionsbefunde, Lebergewichte und histopathologischen Untersuchungen erbrachten keinerlei Hinweise auf eine Leberschädigung. Ebensowenig ergab sich ein Verdacht auf Nierenschädigung aufgrund der klinisch-chemischen-, Harn- und histopathologischen Untersuchungen bei den Tieren bis zur Gruppe von 30 ppm. Blutzucker- und Cholesterin-Spiegel waren bei allen Gruppen im Bereich der Norm.

   Die Messung des systolischen Blutdrucks am Rattenschwanz erbrachte für die behandelten Tiere aller Versuchsgruppen keine höheren Werte als für die Kontrollen.

   Bei der polarographischen Bestimmung von Cadmium konnte eine Speicherung in den Nieren und Lebern festgestellt werden. Die Speicherung war dosisabhängig und nahm mit der Fütterungsdauer zu.

./.

2. 3monatiger Fütterungsversuch an Hunden

Je 2 männliche und 2 weibliche Hunde erhielten Cadmium (als $CdCl_2$) in Konzentrationen von 0, 1, 3, 10 bzw. 30 ppm 3 Monate lang mit dem Futter verabreicht.

Bei den so behandelten Hunden waren Aussehen, Verhalten, Futteraufnahme, Wachstum und Sterblichkeit durch die Zumischung von Cadmiumchlorid in allen Versuchsgruppen nicht verändert.

Zu keinem Untersuchungszeitpunkt wurden irgendwelche hämatologischen Veränderungen in den Gruppen bis 30 ppm festgestellt.

Die eingehenden klinisch-chemischen Untersuchungen, Sektions- und histophatologischen Befunde ergaben keinerlei Hinweise für eine Leberschädigung. Auch die Nierenfunktion wurde nach den Ergebnissen der eingehenden klinisch-chemischen Untersuchungen, der Sektionen sowie aufgrund der histopathologischen Befunde nicht geschädigt. Blutzucker- und Cholesterin-Spiegel wurden durch die Behandlung nicht beeinflußt.

Systolischer und diastolischer Blutdruck waren bei allen Versuchsgruppen bis 30 ppm normal.

Die polarographischen Cadmium-Analysen zeigten eine Speicherung von Cadmium in den Nieren und Lebern bei den Tieren aller Gruppen, auch der Kontrollen an.

Das wesentliche Ergebnis unserer Untersuchungen sei noch einmal zusammengefasst :

1. Während der Versuchszeit kam es zu einer zunehmenden Speicherung des Cadmiums in Leber und Nieren.

2. Trotz dieser Speicherung wurden weder die Leber noch die Nieren geschädigt.

3. Auch eine Schädigung des Blutes konnte nicht gefunden werden.

4. Die nach Cadmium-Aufnahme beschriebene Blutdruckerhöhung konnte weder bei der Ratte noch beim Hund gesehen werden.

5. Schädliche Einflüsse auf Hoden und Ovarien wurden nicht beobachtet.

SUBCHRONIC ORAL TOXICITY OF CADMIUM IN RATS AND DOGS

D. LORKE AND E. LÖSER

Institut für Toxikologie, Wuppertal, Federal Republic of Germany

---

ABSTRACT - If we exclude the industrial toxicological problems of exposure to cadmium, the human intake of this metal is almost exclusively oral. Therefore, in toxicological tests to determine the health risk involved in using objects containing cadmium, the substance must be administered orally.

Tests described in the experiments of this kind are needed inasmuch as the investigations are either not based on oral administration or do not fully take account of the present state of the art.

Firstly we tested the subacute oral toxicity (90-day test) in rats and dogs, with the following results:

1) 3-month feeding experiment on rats

20 male and 20 female rats were fed cadmium (in the form of $CdCl_2$) in doses of 1, 3, 10 and 30 ppm respectively for a period of three months. 40 male and 40 female rats were used as controls.
During the three months of the test, the appearance, behaviour, food intake, growth and mortality rate of the treated rats remained unchanged.
No adverse hematological effects were caused by the three months' treatment.
The clinical and chemical tests as well as the dissection findings, liver weights and histopathological tests produced no evidence at all of liver damage. Neither did the clinical and chemical tests, urinanalyses and histopathological examinations carried out on the animals up to the 30 ppm group show any trace of kidney damage. Blood-sugar and cholesterol levels were within the normal range for all groups.
The systolic pressure readings, taken cordally, were the same for the treated animals as for the controls.
The polarographic tests for cadmium revealed storage in kidneys and liver. The storage level depended on the dose and increased with increasing duration of intake.

2) 3-month feeding experiment on dogs

2 male and 2 female dogs were fed cadmium (in the form of $CdCl_2$) in concentrations of 0, 1, 3, 10 and 30 ppm respectively for a period of three months.
This addition of cadmium chloride did not produce any changes in the appearance, behaviour, food intake, growth or mortality rate of any of the test groups.
At no stage in the experiment was there any evidence of hematological changes in the groups up to 30 ppm.

./.

The exhaustive clinical and chemical tests, the dissection findings and the histopathological findings gave no indication at all of liver damage. Similar tests showed that the kidney function was also unaffected : The treatment had no effect on the blood-sugar and cholesterol levels.
The systolic and diastolic pressure of all the test groups up to 30 ppm was normal.
The polarographic cadmium analyses showed cadmium storage in the kidneys and liver of the animals in all groups, including the control group.

The most significant findings of our tests can be summarised as follows:

1. During the experimental period increasing storage took place in liver and kidneys.
2. Despite this storage, neither liver nor kidneys were damaged.
3. Neither could any adverse hematological effects be determined.
4. High blood-pressure due to cadmium intake, which has been described elsewhere, was not noted in either rats or dogs.
5. Adverse effects on testes and ovaries were not observed.

CRITERIA FROM ANIMALS EXPOSED TO KNOWN CONCENTRATIONS OF NITROGEN DIOXIDE AND OZONE, WITH POTENTIAL USE IN EPIDEMIOLOGY

G. FREEMAN, L. T. JUHOS, W. R. POWELL, N. J. FURIOSI,
R. J. STEPHENS, M. J. EVANS, AND K. D. LUNAN

Stanford Research Institute, Menlo Park, California, USA

ABSTRACT - A realistic concept of the pathogenesis of injury, induced in animals by their residence in ambient concentrations of the oxidizing gas, nitrogen dioxide (NO_2), has been realized for the rat. Also, observations have been made in the monkey, Macacus speciosa. Physiologic and morphologic changes have been investigated starting immediately upon exposure of young animals and then intermittently during an entire lifetime of exposure of rats. Effects varied from an early significant change in respiratory frequency, during exposure to approximately 0.8 ppm of NO_2, to the development of a fatal, chronic disease resembling emphysema in man. Associated physiologic sequellae in terms of respiratory function and polycythemia were studied. More recently, similar observations have been made in rats exposed to ambient concentrations of ozone (O_3), a more injurious component of smog, and to realistic mixtures of the interdependent oxidizing gases, NO_2 and O_3. Clinical, pathologic, physiologic, and hematologic aspects have been studied in parallel.

Experimentally derived data will be discussed in relation to detectable events that may logically be anticipated in man exposed to reasonably equivalent circumstances. The problem of selecting appropriate end points, or criteria, quantifiable by or in man for epidemiologic purposes will be considered from the viewpoint of responses elicited in animals through controlled experimental studies. Included in the considerations will be criteria for both cigarette-smoking and nonsmoking populations because smoking of tobacco is a fairly universal habit. The intended evaluations will be in support of the development of an acceptable spectrum of health-related effects in countries with populations subject to exposure to atmospheres polluted with photochemical oxidants.

POLLUTION DU MILIEU AMBIANT PAR NITRATES ET NITRITES ET POSSIBILITE DE FORMATION DES NITROSAMINES

NICOLAE PREDA

Institut de Médicine et Pharmacie
Laboratoire de Toxicologie, Cluj, Romania

RESUME - La chimie agricole emploie couramment diverses substances pour fertiliser le sol. Les dérivés anorganiques - les nitrites - y sont employés sur une échelle de plus en plus large. Dans certaines conditions de milieu ambiant et par suite d'une application qui ne respecte pas les normes établies, les nitrates s'accumulent dans les plantes à un taux bien supérieur aux limites normales, courantes. Il faut mentionner à ce propos le cas des légumineux qui ont le pouvoir de concentrer les nitrates dans une quantité de 100 fois supérieure aux concentrations habituelles.

Les études faites sur des produits agricoles contaminés avec des nitrates ont démontré que les processus de digestion dans l'estomac des animaux transforment les nitrates en nitrites qui associés aux amines secondaires et tertiaires existantes engendrent les nitrosamines, connues pour leur potentiel cancérigène.

Au cours d'expériences effectuées par nous sur des rats Wistar nous avons réussi à mettre en évidence la formation des nitrosamines dans l'estomac des animaux nourris avec des aliments riches en nitrates.

La chaîne des processus d'industrialisation des produits alimentaires utilise les nitrates et nitrites (substances connues pour leur action methémoglobinisante) en tant que conservants. Par la suite - dans les conditions qui se développent à l'intérieur même des aliments - ainsi que dans le tract stomacal - ces dérivés anorganiques favorisent la formation des nitrosamines.

Au moyen d'une technologie normale nous avons mis en évidence la présence des nitrites dans divers produits alimentaires traités avec des nitrates et nitrites, leur taux variant entre 0,6 mg % et 10 mg %, en fonction du produit respectif, de la durée de maturation et de la température à laquelle le produit était conservé.

Afin d'éviter - en partie au moins - le risque de contamination des produits alimentaires avec des nitrosamines, les normes législatives en vigueur dans notre pays limitent à 7 mg % au maximum les nitrites dans les produits agro-alimentaires, ce qui correspond à moitié des valeurs admises par les réglements de FAO/OMS et des autres pays.

POLLUTION OF THE ENVIRONMENT BY NITRATES AND NITRITES AND THE POSSIBILITY OF THE FORMATION OF NITROSAMINES.

NICOLAE PREDA

Institut de Médicine et Pharmacie
Laboratoire de Toxicologie, Cluj, Romania

ABSTRACT - A variety of chemicals are used today as fertilizers in agriculture. Inorganic derivatives (nitrites) are being used on an ever increasing scale. In certain ambient conditions and where their application does not comply with the standards laid down, nitrates accumulate in plants to levels considerably above the normal permitted limits. Legumes deserve special mention in this context, since they are able to concentrate nitrates up to a level 100 times greater than the normal concentration.

Studies on agricultural products contaminated with nitrates have shown that the process of digestion in the animal stomach transforms nitrates into nitrites, which, when combined with the existing secondary and tertiary amines, give rise to nitrosamines, known for their carcinogenic potential.

During experiments we have demonstrated the formation of nitrosamines in the stomach of Wistar rats receiving a nitrate-rich diet.

Nitrates and nitrites (known for their methemoglobin action) are used as preservatives in a number of industrialized food processes. Subsequently, under the conditions which develop within the treated foods and also within the stomach, these inorganic substances promote the formation of nitrosamines.

Using standard techniques, we have demonstrated the presence of nitrites in various food products treated with nitrates and nitrites, at the levels ranging from 0,6 mg % to 10 mg %, depending on which of the two chemicals was used, the duration of maturation, and the temperature at which the product was stored.

In order to avoid, at least to some extent, the risk of contamination of food products by nitrosamines, the legislative standards in force in our country impose an upper limit of 7 mg % on nitrites in agricultural food products, i.e. half the level acceptable under FAO-WHO regulations and regulations in force in other countries.

APPLICATION DU COMPTEUR COULTER A L'EVALUATION DE LA MESURE DE LA POLLUTION ATMOSPHERIQUE PAR LA MESURE DES PARTICULES SOLIDES EN SUSPENSION DANS L'ATMOSPHERE

J. KUMMER, C. ALLART-DEMUL, D. HEBBELINCKX ET H. BASTENIER

Université Libre de Bruxelles, Belgique

RESUME - Une méthode se basant sur l'utilisation du compteur Coulter est proposée pour mesurer le nombre de particules dans l'atmosphère en fonction de leur dimension.

Des particules atmosphériques sont prélevées sur un filtre en nitrate de cellulose puis sont mises en suspension par dissolution du filtre dans un liquide organique rendu préalablement conducteur. Connaissant la dilution effectuée et la quantité d'air prélevée on peut calculer la courbe de distribution des particules atmosphériques par le compteur Coulter.

Le compteur Coulter est basé sur le principe suivant: un tube en verre ayant une ouverture calibrée est plongé dans un liquide conducteur. De part et d'autre de cette ouverture, se trouve une électrode immergée. On fait circuler le liquide avec les particules en travers de l'ouverture du tube; chaque passage de particule fait varier la résistance entre les deux électrodes et produit une impulsion de tension dont l'amplitude est proportionnelle au volume de la particule. Moyennant des discriminations électroniques, on peut alors faire aisément le comptage suivant diverses dimensions et obtenir la courbe de distribution des particules en suspension.

Nos recherches ont porté sur l'efficacité de différents solvants en vue de réaliser un solvant organique conducteur donnant les résultats les plus stables et les plus reproductibles.

Nous avons effectué par cette méthode une étude comparative de la pollution atmosphérique entre un site rural et un site urbain.

Nous soulignons la facilité, la rapidité, la reproductibilité de cette méthode, les dimensions des particules mesurées pouvant aller de 200 à 0,6 microns.

USE OF THE COULTER COUNTER TO MEASURE SUSPENDED PARTICULATES IN THE ATMOSPHERE

J. KUMMER, C. ALLART-DEMUL, D. HEBBELINCKX AND H. BASTENIER

Université Libre de Bruxelles, Belgium

ABSTRACT - A method based on the use of the Coulter counter is proposed to measure the number of particles present in the atmosphere by size.

Atmospheric particles are collected on a cellulose nitrate filter and placed in suspension by dissolving the filter in an organic liquid which has first been made conductive. From the known degree of dilution achieved and volume of air sampled, it is possible to calculate the distribution curve for the atmospheric particles by means of the Coulter counter.

The Coulter counter is based on the following principle: a glass tube with a calibrated aperture is placed in a conducting liquid. To each side of this aperture there is an electrode immersed in the liquid. The liquid containing the particles is passed through the tube aperture; each particle passing through causes the resistance between the two electrodes to vary, producing a voltage pulse, the amplitude of which is proportional to the volume of the particle. By means of electronic discriminations it is then easy to count the suspended particles according to size and plot their distribution curve.

Our experiments concentrated on testing the efficacity of various solvents with a view to finding a conductive organic solvent which would yield the most stable and most reproducible results.

Using this method we carried out a comparative study of air pollution in a rural and an urban location.

We should like to emphasize that this method is easy, fast and reproducible, and can measure particles of 200 to 0.6u in size.

ULTRASPURENANALYSE ORGANISCHER SCHADSTOFFE IN DER LUFT MITTELS DER SOGENANNTEN THERMOGRADIENTTECHNIK

J. ANGERER, A. HAAG, G. LEHNERT

Zentralinstitut für Arbeitsmedizin der Gesundheitsbehörde der Freien und Hansestadt Hamburg, B.R. Deutschland

KURZFASSUNG

Dieses Anreicherungsverfahren mit anschliessender gaschromatographischer Trennung erlaubt den gleichzeitigen Nachweis von bis zu 40 organischen Komponenten, die in Konzentrationen von weniger als 0,1 ppb in der Luft auftreten. Das Verfahren basiert auf der Anreicherung der Luftbestandteile auf einer klassischen gaschromatographischen Säule im Tieftemperaturfeld, das durch Dampf von flüssigem Stickstoff erzeugt wird. Im Gegensatz zu anderen Methoden wird hier gleichzeitig eine chromatographische Vortrennung erzielt. Das bedeutet eine grössere Selektivität und Spezifität dieses Verfahrens, was der allgemeinen analytischen Zuverlässigkeit des Verfahrens sowie der Nachweisgrenze zugute kommt. Die angereicherte Probe wird anschliessend unter Erwärmung auf eine gaschromatographische Trennsäule aufgegeben, wo eine weitere Trennung der Substanzen stattfindet. Beim Einsatz geeigneter Detektoren wie dem Massenspektrometer (MS) und dem Flammenionisationsdetektor (FID) ist eine gleichzeitige qualitative wie quantitative Bestimmung der Komponenten möglich. Aus unseren Versuchen geht hervor, dass diese Technik reproduzierbar und in Anbetracht der zu gewinnenden Ergebnisse einfach arbeitet und damit den Vorteil der Praktikabilität bietet.

Mit dieser Methode sollte es möglich sein, einen Katalog aller vorkommenden zum Teil bisher unbekannten organischen Verbindungen zu erstellen, die aus umweltmedizinischer Sicht bedeutsam sind. Zwar handelt es sich dabei zumeist um subtoxische Konzentrationen, jedoch ist über deren durch chronische Aufnahme erzielte Wirkung wenig bekannt. Zudem ermöglicht diese Methode eine "Früherkennung" möglicher, neu in die Umwelt emittierter Schadstoffe. Gegenmassnahmen könnten zu diesem Zeitpunkt dann rasch und mit geringem Aufwand getroffen werden, noch bevor sich ein generelles Umweltproblem daraus entwickelt.

ULTRATRACE ANALYSIS OF HARMFUL ORGANIC MATTERS IN THE AIR USING THE SO-CALLED THERMOGRADIENT TECHNIQUE

J. ANGERER, A. HAAG AND G. LEHNERT

Zentralinstitut für Arbeitsmedizin der Gesundheitsbehörde der Freien und
Hansestadt Hamburg, Federal Republic of Germany

ABSTRACT - This concentration process with subsequent partition by gas chromatography enables up to 40 organic substances to be detected simultaneously when present in the air in concentrations of less than 0.1 ppb. The process is based on the concentration of these substances in a conventional gas chromatography column in a low temperature field which is produced by the vapour given off by liquid nitrogen. In contrast with other methods a preliminary chromatographic partition is obtained as well. This makes the process more selective and specific and increases its general analytical reliability and also the detectibility limits. The concentrated sample is heated and introduced into a gas chromatography column and further partition of the substances occurs. Suitable detectors such as the mass spectrometer (MS) and the flame ionization detector (FID) can be used to measure the components both qualitatively and quantitatively. Our tests show that this technique is reproducible. and for the results obtainable provides simple operation, and thus offers the advantage of being practicable.

This method should make it possible to draw up a list of all existing and possibly previously unknown compounds, and which are important from the viewpoint of environmental medicine. It is true that in most cases the concentrations are sub-toxic, but little is known about the effects of a chronic intake of these. This method also makes possible an "early recognition" of potentially harmful substances when emitted into the environment for the first time. Counter-measures could be taken rapidly and economically at this stage, before a general environmental problem developed.

IMPROVED METHODS OF SAMPLING AND ANALYSIS OF AMBIENT HAZARDOUS PARTICULATE POLLUTANTS

R. C. LAO, R. S. THOMAS, L. DUBOIS AND J. L. MONKMAN

Chemistry Division, Air Pollution Control Directorate, Ottawa, Canada

ABSTRACT - The collection, identification and measurement of airborne particulate matter continue to be primary goals of environmental assessment surveys. A broad spectrum of inorganic and organic pollutants posing a potential human hazard are collected by filtration and analysed by a selection of techniques. Attention has been focussed on those compounds whose assayed biological activity has demonstrated carcingenecity or high toxicity at ambient levels. Notable among the class of pollutants are the polycyclic aromatic hydrocarbons (PAH) and compounds of arsenic, selenium and mercury.

A number of analytical schemes have been published for the separation and determination for PAH compounds. Characteristics of these analytical procedures are the extraction, chromatography and final spectroscopy by UV absorption or optical fluorescence. Most recently, the combination of gas-chromatography/mass spectroscopy/computer technique has been successfully applied to PAH analysis. Colorimetric techniques for arsenic, selenium and mercury have been superseded by heated graphite furnace or other flameless atomic absorption techniques which provide highly specific measurements for nanogram or in some instances picogram quantities of these compounds.

The analytical techniques for pollutant assessment have continually undergone evaluation and improvement while few changes have been made to the methodology of collection of the ambient samples. Traditionally airborne particulates have been sampled by drawing a known volume of contaminated air through a filtration medium. The particulate matter entrained by the filter is aliquotted and submitted to analysis. The fact that simple filtration sampling has been universally applied on a routine basis without serious reevaluation has serious implications when it is realized that a number of particulate pollutants with high vapor pressure will either pass through the filter medium without being entrained or will be reevaporated from the particulates collected by the filter.

To enable the collection efficiency of filtration sampling to be evaluated requires detailed data for the physico-chemical properties of the compounds to be analysed. Some standard reference sources contain errors and many of the hazardous compounds of interest have not been thoroughly investigated. The absorption of contaminants on the surface of entrained particulates and subsequent reevaporated effects have been studied. Work now is under way to study these aspects and results will be discussed and applied to the design of new particulate sampling methods.

SURFACE AREA AND ADSORPTION PROPERTIES OF DUST PARTICLES

W. KARCHER, P. GLAUDE, R. DEPAUS

Euratom, CCR Petten, Netherlands

Summary

The surface area and adsorption capacity for benzene has been determined for two natural dust specimens which were obtained by filtration or impaction in an urban (Milan) and rural (Ispra/Varese) area respectively. To distinguish between the adsorption properties of the bulk samples and the respirable size fraction, the same measurements have been repeated for the size fraction with a particle diameter < 5 µm.

The results indicate only marginally higher specific surface areas for the small size fraction than for the bulk specimens. Also, the amount of benzene which can be adsorbed at normal pollution levels (< 1 mg/m^3) is so low (< 1 µg/g) that pollutant removal by a pure adsorption process on dust or aerosol particles, as it has been discussed repeatedly in the literature, seems rather unlikely.

AN IMPROVED TECHNIQUE FOR MONITORING PARTICULATES IN THE ATMOSPHERE TO CHECK AIR QUALITY CRITERIA

J.E. EVENDIJK, A.A. ROOSKEN, N. NIEUWSTRATEN,
Central environmental management service Rijnmond, Schiedam, The Netherlands.

Abstract

Criteria for allowable concentrations of toxic substances in ambient air and tail gases often appear to be incompatible with available measuring methods and apparatus. In the U.S. there is a tendency to combine air quality standards with an analytic method. On the other hand the Dutch proposed standard for SO_2 is coupled with the particulate-concentration, which should be expressed in units of standard smoke according to the O.E.C.D. specification of 1964. When an air quality standard does not indicate a measuring method, the method should be adjusted analytically or technically to that standard.

The councel of Rotterdam declared an air quality standard for particulates in 1970, when south of Hook of Holland an iron-ore terminal started to operate. This standard was clearly inspired by the U.S. standard proposal and the American method of using high volume samplers. In the given regulations was laid down, that by exceeding the standard, activities of the iron-ore terminal should be stopped. This implied continuous monitoring. Because there was no commercially available apparatus that fulfilled the needed requirements, an adequate instrument was developed, to meet the next requirements:

1. The apparatus must be operating continuously
2. Contamination of the filters by the sampler-motor must be avoided
3. Periods between servicing must be as long as possible
4. The instrument should have a constant flow device
5. Inserting new filters in the filterholder must be done in the laboratory to prevent unnecessary damages of the filter
6. Linear air velocity and amount of sucked air must be comparable with that of commercial apparatus.

A description of the instrument is given and some monitoring results are discussed.

ANALYTICAL STUDIES ON THE SPECIATION OF AMBIENT LEVELS OF MERCURY IN AIR

ROBERT S. BRAMAN AND DAVID L. JOHNSON

Department of Chemistry, University of South Florida, Tampa, Florida, USA

ABSTRACT - An analysis method has been developed for the determination of several forms of mercury in air at concentrations down to 0.1 to 1 nanogram per cubic meter. Particulate mercury, elemental mercury, methylmercury (II) compounds, volatile inorganic mercuric compounds and dimethylmercury are collected from air samples onto previously blanked specific absorption tubes. These are analyzed by thermal desorption of the mercury compounds and detection of the mercury by emission spectroscopy in an electrical discharge in helium carrier gas. The mercury emission line at 253.65 nm is used for analysis by means of a conventional recording spectrometer system. The analysis system has a limit of detection near 0.0005 nanograms of Hg. Using sampling rates of 1.5 liters per minute for 2 hours gives a limit of detection of 0.03 ng m^{-3} for elemental mercury, dimethylmercury and particulate mercury. The specific absorption tubes for methylmercury (II) compounds and volatile inorganic mercuric compounds have limits of detection near 0.3 ng m^{-3}. The selection absorption tubes are connected in series in the following order. A glass filter mat (0.3 micron) removes particulate mercury. A Chromosorb-W column (45/60 mesh gas chromatography inert support) coated with 3% by weight of a high temperature silicone and treated with HCl vapors removes mercuric chloride and similar compounds, but passes the other forms. The next tube consists of a NaOH treated Chromosorb-W (not siliconized) and removes methylmercury (II) compounds. The next tube has, in order, a layer of silver coated 60/80 mesh glass beads and a layer of gold coated 60/80 mesh glass beads. The silvered glass beads remove elemental mercury while passing dimethylmercury. Dimethylmercury is quantitatively absorbed by the gold coated beads. The analysis of ambient air for the several forms of mercury has been carried out over a sampling grid in the Tampa, Florida area. Diurnal variations, short term fluctuations, mercury forms in homes and buildings, and mercury evolution from lakes have also been studied.

Results of air analysis from a speciation study in several large cities of the Eastern USA and over the Western Atlantic Ocean will also be presented. Current results indicate that elemental mercury is the major form encountered in air but substantial amounts of methylmercury (II) compounds and the volatile inorganic mercuric chloride-like compounds can also be present. Total mercury (mostly mercury metal) was found to be 10 to 50 times higher in concentration in homes and buildings than in outside air. It is apparent that verification of the type of mercury compounds present in air is essential because of the higher toxicity of the methylated forms and mercuric chloride over that of elemental mercury. The method described here is the only approach so far available for carrying out this type of air speciation study.

NEW TECHNIQUES FOR THE MEASUREMENT OF AMBIENT AIR POLLUTANTS

JAMES R. McNESBY

National Bureau of Standards, Washington D.C., USA

ABSTRACT - Measurement research in air pollution at the National Bureau of Standards includes that applicable to ambient air, stack emissions, and automotive emissions. Some of the measurement techniques developed for source emission application have been refined and made sufficiently sensitive to measure pollutant concentrations as low as background levels. The fluorescence monitor for sulfur dioxide developed by Dr. Okabe and his colleagues has been applied commercially to the problem of stack monitoring. More recently the sensitivity of the technique has been improved very substantially so that ambient air sulfur dioxide concentrations can be measured at least down to 1 part in 10^9. This apparatus will be described and its capabilities delineated. The technique of laser magnetic resonance for the measurement of NO at concentrations typical of stack emission and auto exhaust has similarly been extended to include ambient concentrations. In addition, progress has been made in the direction of simultaneous measurement of NO_2 by the same technique. The most recent data obtained by the laser magnetic resonance technique will be presented. A third measurement technique developed at the National Bureau of Standards, that of dual angle, forward laser scattering for the real time measurement of particle size distribution has now been shown to be capable of revealing morphological and chemical information. The development of pyrolysis as an alternative to permeation tubes and standard gas cylinders will be described. The principle of the pyrolytic technique is that a thermally stable molecule which may be stored indefinately is subjected to thermal decomposition producing a non-storable molecular species plus an exactly equal number of storable, readily measured molecular species. The pyrolytic technique has the inherent capability of tying together virtually all gaseous pollutant molecules in a single, self-consistent measurement and calibration scheme.

Finally, an absolute coulmetric technique for the determination of parts per million concentrations of NO in nitrogen will be described. The technique has been used to generate confirmatory evidence for establishing the integrity of NO in nitrogen Standard Reference Materials.

SPECIFIC HYDROCARBON MONITORING AT LOW CONCENTRATIONS

R. PERRY AND JOHN D. TWIBELL

Public Health Engineering, Imperial College, London, England

ABSTRACT - The extensive use of hydrocarbons and the wide variation in their physiological effects necessitates a more detailed study of the hydrocarbon composition of the atmosphere. Total hydrocarbon measurements, the method used extensively at present, give no indication of the levels of the individual potentially dangerous compounds present in the carbon atmosphere.

One of the major problems involved in studying the medical effects of individual hydrocarbon air pollutants is that of sampling, at street air concentrations, in such a way as to render subsequent separation and analysis possible. If, for instance, adsorption tubes containing standard chromatographic materials are used at sub ambient temperatures, difficulties arise with water condensation. In addition the amounts of volatile materials collected are limited by the relatively low retention volumes involved. These problems of sampling and analysis can be overcome by use of the "Timed Elution Procedure". Here the hydrocarbons are sampled quantitatively at ambient temperatures by adsorption onto Chromosorb 102 packed into stainless steel tubes. These tubes are then heated to 130°C and a proportion of the collected material is eluted via a sampling valve onto the main chromatographic column for analysis. The elution is accurately timed over a short period such that the sample is rapidly introduced, in a small plug of carrier gas, onto the column. For a given sampling tube, the proportion of each species eluted in this timed-interval is a linear function of the total amount collected. The elution procedure may be repeated several times for the same sample allowing both quantitative analysis and, if necessary, G.C./M.S. identification of the species present.

This technique allows, for example, street air benzene levels to be readily assessed. It is also important in that it is within the C_6- C_{10} hydrocarbon range that petrol and diesel exhaust emissions differ most markedly. These hydrocarbons can be readily sampled and separated by this method and their relative contributions to the street air hydrocarbon levels may be measured. Very low levels of alkylbenzenes, indans and tetralins, which contribute to exhaust odour can also be estimated.

The techniques described are currently being used in a survey of the region around Heathrow Airport, London. Benzene levels are being determined and the relative contributions to total hydrocarbon levels from petrol, diesel and aircraft engines are being assessed.

A SYSTEM FOR THE RAPID IDENTIFICATION OF TOXIC ORGANIC POLLUTANTS IN WATER

WILLIAM T. DONALDSON, MIKE H. CARTER, JOHN M. McGUIRE

Southeast Environmental Research Laboratory
United States Environmental Protection Agency, Athens, Georgia, U.S.A.

ABSTRACT

A system has been developed that will identify, within a few hours, any of eight thousand organic compounds in water at concentrations as low as 0.01 µg per liter. A one-liter sample of water is extracted with an appropriate, water-immiscible, organic solvent. After the extract is concentrated to 100 to 1.000 microliters, a portion is injected into a gas chromatograph coupled to a computer-controlled mass spectrometer. As separated compounds pass through the mass spectrometer, spectra are recorded on magnetic disks frequently enough to obtain several spectra for each compound.

Compounds are identified from their mass spectra by computerized spectra matching. A central computer library contains spectra for eight thousand compounds. The computer selects and lists the compounds whose spectra are similar to that of the unknown, in order of their degree of similarity. The computer also assigns a numerical value for the similarity between the unknown and each listed spectrum from the library, giving the analyst a high degree of confidence in the reliability of the identification. Further confirmation of the compound's identity can be made by comparing gas chromatograph retention times and by obtaining infrared absorption spectra or chemical ionization mass spectra.

With approximately twenty-five mass spectrometers located throughout the United States, the laboratories of the Environmental Protection Agency can contribute to the continuous recording of the geographic frequency distribution of toxic pollutants. When a spectrum is referred to the central computer together with the location of the sampling site from which the corresponding compound was obtained, the computer automatically records the location for each identified compound.

The library of spectra is being upgraded continually by carefully elucidating the structures of previously unidentified organic water pollutants. High-resolution mass spectra, infrared spectra and nuclear magnetic resonance spectra are used in the initial identification of pollutants whose spectra are not in the computer library. Once their identities are certain, the spectra are added to the library.

The computer usually identifies over half of the compounds in samples from a wide variety of industrial waste effluents. In many cases the total cost for an identification is less than ten dollars.

VERGLEICHENDE SCHWERMETALLANALYTIK MIT HILFE DER POLAROGRAPHIE UND ATOMABSORPTION - MOEGLICHKEITEN UND GRENZEN DER REPRODUZIERBARKEIT

W. EGELS UND G. CRÖSSMANN

Landwirtschaftliche Untersuchungs- und Forschungsanstalt,
Münster, B.R. DEUTSCHLAND

KURZFASSUNG

Für die Analyse von Schwermetallen wurden verschiedene Untersuchungsverfahren entwickelt, deren erfolgreiche Anwendung nicht zuletzt konzentrationsabhängig und materialbedingt ist. Bei der Feststellung der Umweltverschmutzung durch Schwermetalle haben sich u.a. polarographische und atomabsorptionsflammenphotometrische Methoden bewährt; jedoch ist die Vergleichbarkeit der von verschiedenen Instituten erarbeiteten Untersuchungswerte noch vielfach infrage gestellt, weil es an allgemein verbindlichen Standardvorschriften für den Einsatz dieser Verfahren fehlt, was wenigstens zum Teil daran liegen dürfte, dass die Möglichkeiten und Grenzen der Reproduzierbarkeit nicht genügend bekannt sind. Wir haben daher versucht, möglichst viele Einzelfaktoren zusammenzutragen, die auf das Untersuchungsergebnis von Einfluss sind, um namentlich Gesetzmässigkeiten zu erkennen, aus denen systematisch bedingte und erklärbar auftretende Analysenfehler abzuleiten sind. In dieser Weise wurden die beiden genannten Methoden einzeln und im Vergleich zueinander überprüft. Neben den erforderlichen Modell-Lösungen wurde Welsches Weidelgras - Lolium multiflorum L. - als Testmaterial eingesetzt, weil diese Pflanze von uns als Dauer- oder Wechselgraskultur bei der Ermittlung von Immissionswirkungsraten von Industriestäuben auf pflanzliche Materialien in grösserem Umfang benutzt wird.

Mit Hilfe der Inverspolarographie lassen sich sowohl für Blei als auch für Cadmium, denen neben einigen anderen Schwermetallen unser besonderes Interesse gilt, anhand von wenigen Messwerten Eichkurvensysteme aufstellen, die für alle anwendbaren Empfindlichkeitsstufen (1×10^{-6} bis 5×10^{-10}) gültig sind und einen sehr grossen Messbereich umfassen. Das Mass der Reproduzierbarkeit hängt von der Einhaltung bestimmter Messbedingungen ab, über die im einzelnen berichtet wird. Auch der Einfluss der beiden genannten Elemente und anderer zueinander unterliegt deutbaren Gesetzmässigkeiten, deren Kenntnis für eine richtige Auswertung der Polarogramme von grösster Wichtigkeit ist.

Bei der Atomabsorption wurden die Messbereiche für Blei und Cadmium ebenfalls nach dem Mass der möglichen Reproduzierbarkeit abgesteckt und hierbei Kurvenkorrektionen auf den Linearbereich erarbeitet.

./.

Unter Berücksichtigung der für die beiden Messverfahren aufgestellten und näher definierten Einflussfaktoren ergeben sich Empfehlungen für bestimmte Abschnitte der in der Umweltanalytik benötigten Messbereiche, in denen die eine und die andere Methode wechselseitig hinreichend genau reproduziert werden kann oder bei denen nur jeweils eines der überprüften Messverfahren so geeignet ist, dass von der Methode her keine wesentlichen Verfälschungen der Analysenwerte zu erwarten sind. Bei der Reproduzierbarkeit der in der Umweltanalytik als möglicherweise verbindlich zu benutzenden Untersuchungsmethoden kommt es daher, wenn Standardvorschriften mit brauchbaren Analysenspielräumen erarbeitet werden sollen, nicht nur auf das Messprinzip als solches, sondern wesentlich auf die Einhaltung der durch das Messprinzip bedingten günstigen Messbereiche an, die nur bei Kenntnis sämtlicher Störfaktoren abgesteckt werden können.

COMPARATIVE HEAVY METALS ANALYSIS BY POLAROGRAPHY AND ATOMIC ABSORPTION - POSSIBILITIES AND LIMITS OF REPRODUCIBILITY

W. EGELS UND G. CRÖSSMANN

**Landwirtschaftliche Untersuchungs- und Forschungsanstalt,
Münster, Federal Republic of Germany**

ABSTRACT-Various test methods for the analysis of heavy metals were developed, the success of which depended to a great extent on the concentration and the type of material. Polarographic and atomic absorption/flame photometry have been among the most effective methods for the determination of environmental pollution by heavy metals; the comparability of experimental values obtained by various institutes is, however, still widely questioned since there are no generally binding regulations for the use of these methods. This is probably due at least in part to the fact that the possibilities and limits of reproducibility are not sufficiently known. We have therefore attempted to combine the greatest possible number of individual factors affecting experimental results, in order to find laws governing systematic and explicable analysis errors. The two methods mentioned were tested separately and in comparison with one another. In addition to the necessary standard model solutions tests were also carried out with Italian ryegrass (Lolium multiflorum L.), since this plant is employed by us extensively as permanent or rotating grass culture for determination of the levels and effects of the immissions of industrial dusts on plant materials.

Using inverse polarography, systems of calibration curves valid for all degrees of sensitivity (1×10^{-18} to 5×10^{-10}) used and covering a very great measuring range, were plotted on the basis of a few measurement values, for both lead and cadmium which, in addition to some other heavy metals, are of particular interest to us. The degree of reproducibility depends on the observance of certain measurement conditions which are described in detail. The effect of the two elements mentioned, and others, on one another is also subject to clearly-defined laws, knowledge of which is of the utmost importance for correct interpretation of the polarograms.

./.

In the case of atomic absorption, the measuring ranges for lead and cadmium were likewise plotted according to the extent of reproducibility possible and curve corrections determined for the linear graph.

Taking into account the influencing factors ascertained and defined for both measurement methods, recommendations may be made for certain sections of the measuring ranges required in environmental analysis, in which both methods can be reproduced with sufficient accuracy, or in which only one of the measurement methods tested is sufficiently reproducible, for no appreciable falsification of the analysis values resulting from the method to be likely. The reproducibility of experimental methods which might be made compulsory for environmental analysis depends, if standard regulations with suitable analysis margins are to be set, not only on the measurement method as such, but to a great extent on keeping to measurement ranges suitable for that particular method, which can only be determined when all the interference factors are known.

SPURENNACHWEIS SCHAEDLICHER ELEMENTE IN LUFT, WASSER UND BIOLOGISCHEN MEDIEN MIT DER ROENTGENFLUORESZENZANALYSE

LIESELOTTE BEITZ, JOACHIM HAASE, NORBERT WEICHERT

SIEMENS, Bereich Meß- und Prozeßtechnik,
Karlsruhe, B.R. Deutschland

KURZFASSUNG

Zur Untersuchung der Wirkung der Umweltverschmutzung auf den Menschen ist die chemische Ueberwachung der Bereiche Luft- Wasser- Boden sowie die Kontrolle pflanzlicher und tierischer Produkte von grundlegender Bedeutung.

Es sind umfangreiche Untersuchungen notwendig, um exakte und statistische Aussagen über die heutige Belastung der Atmosphäre und der biologischen Medien zu erhalten. In Zusammenarbeit mit der Medizin müssen die toxischen Grenzkonzentrationen schädlicher Elemente wie S, Pb, Cd, Zn, As, Hg und Sb festgelegt werden.

Neuere Untersuchungen haben ergeben, dass die Röntgenfluoreszenzanalyse (RFA) wegen ihrer kurzen Analysenzeit (40 bis 800 sec.), ihrer hohen Reproduzierbarkeit der Messwerte und ihrer vollständigen Automatisierbarkeit erfolgreich zur Lösung der oben angesprochenen Probleme eingesetzt werden kann.

Zur Analyse der Luft werden Spurenelemente auf geeignete Filter derart angereichert, dass definierte Luftvolumina durch diese Filter gesaugt werden. Ein Vergleich mit Standardproben gestattet eine quantitative Analyse mit einer Genauigkeit von 1 bis 5 % relativ. Die nachweisbaren Grenzkonzentrationen liegen – je nach Element – bei 1 bis 30 ng/cm^2 Filterfläche.

Zur Analyse des Wassers werden einige ml Wasser in speziellen Bechern eingedampft. Die Becher mit dem Eindampfrückstand können direkt vermessen werden. Die erreichbaren Nachweisgrenzen liegen bei ca. 0,01 bis 0,05 /ug abs, die Analysengenauigkeit beträgt ca. 1 % relativ.

Die Analyse von Schadstoffen in pflanzlichen Produkten erfolgt an getrocknetem, zerkleinertem und tablettiertem Material. Die nachweisbaren Grenzkonzentrationen liegen bei 0,1 bis 0,5 ppm, die Analysengenauigkeiten bei 1 ... 10 % relativ.

Im Rahmen der schädlichen Umwelteinflüsse auf den Menschen ist die Analyse von tierischen Produkten von ausserordentlichem Interesse. Zur Durchführung dieser Analysen werden ca. 20 g des Produktes getrocknet, zerkleinert und tablettiert. In einer Messzeit von 800 sec. werden an Fleischproben für Pb, As, Hg, Sb und Cd Nachweisgrenzen von 20 bis 30 ppb (0,02 bis 0,03 ppm) erhalten. Die Analysengenauigkeit von 1 ... 10 % relativ entspricht auch hier den Anforderungen der Praxis.

DETECTION OF TRACES OF NOXIOUS SUBSTANCES IN AIR, WATER AND BIOLOGICAL MEDIA USING X-RAY FLUORESCENT ANALYSIS

LIESELOTTE BEITZ, JOACHIM HAASE, NORBERT WEICHERT

SIEMENS, Bereich Meß- und Prozeßtechnik,
Karlsruhe, Federal Republic of Germany

ABSTRACT- In the investigation of the effect of environmental pollution on human beings, chemical monitoring of the air, water and earth, as well as examining vegetable and animal products, is of fundamental importance.

Comprehensive investigations are necessary to obtain exact statistics and other data on the present burden on the atmosphere and biological media. The critical toxic concentrations of noxious substances such as S, Pb, Cd, Zn, As, Ng and Sb must be laid down in collaboration with the medical profession.

Recent research has shown that X-ray fluorescent analysis (XFA) can be used successfully to solve the problems quoted above on account of the short time required for the analysis (40-800 secs.), the high reproducibility of the values and the possibility of total automation.

To analyse the air, trace elements are concentrated on suitable filters in such a manner that defined volumes of air are drawn through these filters. A comparison with standard samples permits quantitative analysis to a relative accuracy of 1-5%. The demonstrable critical concentrations range - depending on the element - from 1 to 30 mg/cm^2 filter surface.

To analyse water, several ml water are evaporated in special beakers. The beakers with the total concentrated residue can be measured directly. The detection limits obtainable are between approximately 0.01 and 0.05 micrograms absolute, the relative analysis accuracy is approximately 1%.

The analysis of noxious substances in vegetable products is carried out on dried, crushed and pelletized material. The demonstrable critical concentrations range from 0.1 - 0.5 ppm, the relative accuracy of analysis is 1 - 10%.

In the study of the noxious environmental influences on man, the analysis of animal products is of very great interest. To carry out these analyses, approximately 20 grams of product are dried, crushed and pelletized. Within a measuring time of 800 secs., detection limits of 20 - 30 ppb (0.02 - 0.03 ppm) are obtained with samples of meat for Pb, As, Hg, Sb and Cd. At 1-10%, the relative accuracy os analysis meets practical requirements here as well.

DETECTION DE COMPOSES CANCEROGENES PAR SPECTROSCOPIE DE LUMINESCENCE A BASSE TEMPERATURE

B. MUEL, C. HOUEE, M. HUBERT-HABART

Fondation Curie - Institut du Radium, Paris, France

RESUME

On ne sait pas quelles sont les concentrations minimales de cancérogènes susceptibles de présenter un risque pour l'homme par expositions prolongées des voies respiratoires ou par ingestions régulières. Il est donc nécessaire de pouvoir identifier et doser de très petites quantités de substances cancérogènes au sein de mélanges complexes que sont par exemple les fumées ou certains aliments, afin de contrôler dans les meilleures conditions la contamination de l'environnement par ces substances. La technique habituelle consiste, après enrichissement chromatographique, à détecter le composé recherché en spectroscopie d'absorption ou mieux de fluorescence, à température ambiente. Le plus souvent, ces méthodes sont assez sensibles mais elles ont une spécification assez médiocre du fait que les spectres obtenus présentent des bandes très larges et peu nombreuses.

Nous voulons attirer l'attention sur l'intérêt de l'application aux problèmes de pollution d'une technique assez simple que nous utilisons depuis plusieurs années et qui permet souvent d'améliorer considérablement la spécificité et la sensibilité de la détection de certains cancérogènes. Cette technique consiste à observer la fluorescence de solutions congelées à la température de l'azote liquide. A basse température, on constate fréquemment une augmentation du rendement de fluorescence et un affinement des bandes spectrales. L'exemple le plus frappant de ce dernier phénomène est celui que présente le benzo- (a)-pyrène excité à 365 nm dont le spectre à basse température en solution dans l'octane, présente plus de 50 bandes de fluorescence très fines qui permettent de le reconnaître en présence d'une quantité 10.000 fois plus grande de goudron. Pour cette molécule, la sensibilité ultime de la détection est de 10^{-10}g et la technique peut être rendue quantitative grâce à une méthode de dosage par surcharge (1). On peut appliquer ce procédé à de nombreux autres hydrocarbures aromatiques, les meilleurs résultats sont obtenus en excitant dans chaque cas à la longueur d'onde d'une bande d'absorption intense de l'hydrocarbure considéré (2). Récemment, nous avons utilisé la luminescence à basse température pour la détection des aflatoxines (3).

(1) B. MUEL, G. LACROIX, Bull. Soc. Chim. Fr. 2139-2147, 1960.

(2) D. LAVALETTE, B. MUEL, M. HUBERT-HABART, L. RENE, R. LATARJET J. Chim. Phys. 65, 2144-2149, 1968.

(3) C. HOUEE, B. MUEL, M. HUBERT-HABART, C.R. Acad. Sc. Paris, 276, 2333-2336, 1973.

MONITORING OF CARCINOGENIC COMPOUNDS BY LOW-TEMPERATURE LUMINESCENCE SPECTROSCOPY

B. MUEL, C. HOUEE, M. HUBERT-HABART

Fondation Curie - Institut du Radium, Paris, France

ABSTRACT- We do know what are the minimum carcinogen concentrations likely to involve risk to man through prolonged exposure of the respiratory passages or regular ingestion. In order to determine the level of environmental contamination by carcinogenic substances under optimum conditions, we must be able to identify and estimate the proportions of minute quantities of these substances in such complex mixtures as smoke or certain foods. The usual technique is to detect the compound in question after chromatographic treatment, by absorption spectroscopy or better, by fluorescence spectroscopy at ambient temperature.

Mostly these methods are fairly sensitive, but their specificity is rather poor, as the resultant spectrum bands are very wide and few in number.

Because of its bearing on pollution problems, we should like to draw attention to a fairly simple technique which we have been using for several years and which in many cases improves considerably the specificity and sensitivity with which certain carcinogens can be detected. This technique consists in observing the fluorescence of solutions frozen to the temperature of liquid nitrogen. At low temperature an increase in fluorescene efficiency and a narrowing of the spectrum bands are often noted. The most striking example of this second phenomenon is that of benzo-(a)-pyrene excited to 365 nm; the spectrum at low temperature in an octane solution shows over 50 very narrow fluorescene bands which enable the material to be determined in the presence of 10,000 times as much tar. For this molecule, the maximum sensitivity of detection is 10^{-10}g, and the technique can be quantified by a method of estimating with excess sorbent (1). This process can be applied to many other aromatic hydrocarbons, the best results being achieved when the excitation in each case corresponds to the wavelength of an intense absorption band of the hydrocarbon in question (2). Recently we have used low-temperature luminescence for the detection of aflatoxins (3).

(1) B. MUEL, G. LACROIX, BULL, Soc. Chim. Fr. 2139-2147, 160.

(2) D. LAVALETTE, B. MUEL, M. HUBERT-HABART, L. RENE, R. LATARJET, J. CHIM. PHYS. 65, 2144-2149, 1968.

(3) C. HOUEE, B. MUEL, M. HUBERT-HABART, C.R. Acad. Sc. Paris, 276, 2333-2336, 1973.

TOXICOLOGIC ASSESSMENT OF THE HEALTH EFFECT OF SULPHUR DIOXIDE AND SULFATE PARTICULATES

J. WESLEY CLAYTON Jr.

Health Effects Division

Environmental Protection Agency, Washington DC, U.S.A.

ABSTRACT - The health effects of particulates in the inhalation of sulfur dioxide and other gases has not yet been satisfactorily defined. It is known that several factors contribute to the biological response elicited when particles and gases are inhaled. Among these are the size of the particle, its shape, the concentration of particles in the gas medium, and the physio-chemical properties of the particulate, especially its reactivity with components of the gaseous phase and its solvent action related to the gaseous phase.

Epidemiological and analytical data from the air pollution episodes as Donora (1948), the Meuse Valley (1930), London (1952), and others show that the concentration of one pollutant alone, e.g., sulfur dioxide, is insufficient to account for the excess morbidity and mortality recorded from these episodes. Thus, it has been inferred that the mere association or combination of several air contaminants are responsible for the effects on health, although the specific details of the combination (s) have not yet been established.

While sulfur dioxide in sufficient concentration is a respirattry irritant, it rarely, if ever, occurs at irritation concentrations in the urban environment even in "episodes." It has become, therefore, a so-called "index of pollution" and not a cause per se of health consequences. On the other hand, the Air Quality Standards which have been promulgated under the Clean Air Act Amendments of 1970 do reflect public concern for putative health effects of sulfur dioxide. In contrast, some long-term animal studies seem to indicate lack of deleterious health effects from sulfur dioxide inhalation. For example guinea pig (12 months) and monkey (18 months) studies have demonstrated that little harm, if any, attaches to sulfur dioxide at levels of 5.0 ppm, two orders of magnitude more than the Air Quality Standard for sulfur dioxide. The lower concentrations, namely, 0.1, 0.5, and 1.0 ppm, employed in this study likewise produced no detrimental effects in guinea pigs and monkeys.

./.

On these grounds it then becomes important to examine the health effects of the particulate matter dispersed in the urban air, notably, particulate sulfate aerosols which result from catalytic oxidation of the sulfur dioxide effluent from stationary power sources, or from catalytic converters employed to reduce carbon monoxide and hydrocarbone emissions from mobile sources of pollutants.

The particulate matter dispersed in the atmosphere is composed of a large variety of chemical elements and compounds. The biological activity of some of these substances - fluorides, berylium, mercury, chromium, cadmium, lead, and asbestos, to cite a few - is known from industrial exposures and toxicological studies. This knowledge, however, is related to the substance alone and not as it might act in concert gaseous materials. There are undoubtedly other particulates which may exert an adverse effect on health but for which little or not toxicity data are available.

The study described in this paper on the particulate, obtained by high-volume sampling from four coal-burning plants in the Eastern United States disclosed no injurious effects when particulate of < 5 microns in diameter was inhaled by monkeys for 18 months, 22 hours a day, at concentrations of 100 or 500 ug/m3. Monkeys and guinea pigs continuously exposed to sulfur dioxide at 0.1, 1.0, or 5.0 ppm/ (260, 2600, or 13000g/m3) each mixed with 500ug/m3 of particulate demonstrated no harmful effects from exposure to these mixtures. On the other hand inhalation of sulfate particulate at concentrations of 400ug/m3 to 500ug/m3 caused respiratory impairment and lung damage in monkeys exposed to this range of concentrations for 18 months.

In spite of the lack of apparent injurious effects from sulfur dioxide in the long-term studies cited above, it has been shown by Amdur and Underhill (Arch. Environ. Health 16:460 [1968] that sodium chloride aerosol (10 mg/m3) exacerbates the irritancy properties of sulfur dioxide (2 ppm) as determined by increased pulmonary flow resistance following single, one-hour exposures of guinea pigs. Furthermore, aerosols of other salts, for example, potassium chloride and ammonium thiocyanate, in which sulfur dioxide is more readily soluble, produced a greater enhancement of the irritant effect than equivalent air concentrations of sodium chloride. The authors infer from these data that the resistance to airflow through the respiratory tract is a function of the solubility of sulfur dioxide in the particulate aerosol.

Further information has been developed which suggests that the irritant properties of sulfur dioxide might not only be enhanced by its solubility in a particulate phase but also by its subsequent oxidation to sulfuric acid. Preliminary studies by Amdur and Underhill (vide infra) have shown that insoluble, solid aerosols, such as carbon, manganese dioxide, fly ash, triphenylphosphate, and iron oxide, were inactive in potentiating the irritant effect of sulfur dioxide in guinea pigs exposed for one hour. However, soluble, solid aerosols,

./.

such as manganese chloride, sodium orthovanadate, and ferrous sulfate, all significantly potentiated the irritant property of sulfur dioxide.

It is evident from these toxicologic data that not all airborne contaminants potentiate the irritant action of sulfur dioxide in single exposures, but that potentiation of toxic effects is dependent on the ambient catalysis of sulfur dioxide and SO_4 = and the latter on the oxidizing capacity of the catalytic aerosol. Many sulfates in aerosol form possess far greater toxicologic activities than sulfur dioxide. The health consequences of the conversion of sulfur dioxide to sulfate either in the atmosphere or as a result of the oxidation of sulfur in fuels by catalytic converters demand increased research before an adequate margin of safety care be defined for sulfate emissions.

BIOLOGICAL EFFECTS OF THE POLYCHLORINATED BIPHENYLS IN NONHUMAN PRIMATES

J.R. ALLEN, L.A. CARSTENS, D.H. NORBACK

Department of Pathology, and Regional Primate Research Center,
University of Wisconsin, Madison, Wisconsin, U.S.A.

ABSTRACT - In a series of experiments adult rhesus monkeys were fed diets containing 25, 100, and 300 ppm of a polychlorinated biphenyl (PCB) (Aroclor 1248, Monsanto Co., St. Louis, Missouri, U.S.A.) for periods of 2 to 3 months. The total PCB intake for animals during this period varied from 250 to 300 mg for the 25 ppm group, 0.8 to 1 g for the 100 ppm group, and 3.6 to 5.4 for the 300 ppm group. It was established that all of these doses produced symptoms and lesions compatible with PCB intoxication within one month. Mortality occurred on the larger doses within 2 months and on the lower dose within 4 months. The biological modifications that were recorded in these animals included loss of weight, alopecia, subcutaneous edema particularly of the face, acne, conjunctivitis, ascites, hydrothorax, gastric mucosal hypertrophy and hyperplasia, liver hypertrophy, and bone marrow hypoplasia. Terminally, these animals had decreased hemoglobins, hematocrits, and serum protein, shifts in the albumin-globulin ratio, and a relative neutrophilia. Biochemically, the hypertrophied liver of these animals had a relative decrease in DNA due to the proliferation of the cytoplasmic components, namely the smooth endoplasmic reticulum (SER) of the hepatic cells. Associated with the proliferated SER was an increase in microsomal protein and stimulated enzyme activity.

In the animals of the 25 ppm group that survived, alopecia, focal edema, and acne persists after 1 year. In addition, relatively high levels of PCBs remain in the adipose tissue and liver. The liver continues to be enlarged, and the activity of hepatic microsomal enzymes remains elevated.

In contrast to the injurious effects mentioned above suffered by the adult monkeys exposed to PCBs, one-month-old infants fed 1 g (35 mg/kg body weight) of PCB over a thirty day period were essentially free of any of the clinical, gross, microscopic, or biochemical alterations attributable to the PCBs. When tissue levels of PCBs in the infants and adults that received similar doses were analyzed by gas chromatography it was established that lower levels were present in the neonatal tissues.

./.

Other experiments have shown that approximately 10 percent of a single dose of PCB was recovered within 14 days from the hexane extracted urine and acetone extracted feces with the greatest percentage being eliminated between the second and eighth day. When the tissues of these animals were analyzed for their PCB content, it was determined that the largest concentration was present in the adipose tissue and secondly in organs having high fat contents. Gas chromatography of these tissue extracts showed proportional changes and absence of peaks at short retention times thus indicating the possibility of selective absorption from the gastrointestinal tract or compositional modifications of the PCB mixture by the liver. Employing ^3H labelled 2,5,2',5' -tetrachlorobiphenyl, a component of PCB, it was found that this compound was modified *in vivo* quite extensively. The radioactivity in urine was no longer from 2,5,2',5' -tetrachlorobiphenyl but was derived from its metabolite.

These data indicate that (1) The symptoms and lesions that develop in the nonhuman primate are striking similar to those reported to occur in accidental human exposure to the PCBs. (2) Relatively small amounts of PCB in the diet for a short period are capable of causing morbidity and mortality. In surviving animals signs of PCB intoxication and moderately high tissue levels of PCBs persist after 1 year. (3) Indications are that a large percentage of the PCBs are absorbed from the gastrointestinal tract, modified in the liver, and deposited primarily in the adipose tissue. (4) Excretion of these metabolically altered PCBs occurs primarily by way of the biliary route. (5) Infants are able to tolerate doses of PCB that are lethal to adults.

CONCENTRATION DU PLOMB DANS L'EAU POTABLE ET PLOMBEMIE D'UNE POPULATION ADULTE

J. DE GRAEVE, P. JAMIN, D. RONDIA

Université de Liège et
Centre de transfusion sanguine de Verviers, Belgique

RESUME - La charge corporelle totale en plomb dépend principalement de deux voies d'entrée des composés plombifères:

1. - Les bronches et les alvéoles, voie d'entrée des particules et fumées accompagnant les gaz d'échappement des véhicules à moteur.

2. - Le tube digestif, voie d'entrée du plomb alimentaire, celui-ci trouvant son origine dans la composition du sol où l'aliment a été produit, dans la composition du récipient dans lequel l'aliment a été conservé ou pour certains enfants, dans la composition des substances habituellement portées à la bouche.

Dans un travail précédent, réalisé dans une région de l'Est de la Belgique, on a démontré que dans une ville de 35.000 habitants environ, l'agressivité de l'eau potable était responsable d'une lente dissolution des canalisations en plomb, qui équipent encore environ 50% de l'habitat. Dans ces eaux, la concentration du plomb varie de 1 à 1,5 mg/l. Lorsque les canalisations ne sont pas en plomb la concentration de ce métal n'excède pas 0,15 mg/l.

Dans les faubourgs de cette même ville, l'eau potable est dure ou durcie artificiellement et les concentrations du plomb sont en général inférieures à 0,03 mg/l, quelle que soit la nature du matériau constituant les canalisations.

Comme la concentration du plomb sanguin constitue un miroir relativement fidèle de la charge corporelle totale en plomb et comme cette concentration est facilement mesurable avec une précision suffisante, il était intéressant d'étudier, sur une population adulte très large, les répercussions d'une entrée constante de plomb dans l'organisme pendant plusieurs années à doses journalières faibles.

L'étude porte sur environ 1200 donneurs de sang des deux sexes âgés de 20 à 65 ans, habitant la région de Verviers. Ils ont été divisés en quatre groupes selon la nature de leur eau potable et du matériau des canalisations :

./.

Groupe 1 : eau douce avec canalisation en plomb.

Groupe 2 : eau douce avec canalisation en autre matériau.

Groupe 3 : eau dure avec canalisation en plomb.

Groupe 4 : eau dure avec canalisation en autre matériau.

Les résultats de l'enquête sont très significatifs. Ils montrent que la partie de la population soumise au risque (groupe 1) a une plombémie deux fois plus élevée que le reste de l'échantillon dont la plombémie correspond à la valeur normale communément admise (groupe 1 : 26,9 µg/100 ml, groupe 3 : 14,9 µg/100 ml, groupe 4 : 13,3 µg/100 ml). La pollution de l'air, les habitudes alimentaires et le niveau socio-économique des différents groupes étant équivalents, les facteurs professionnels étant éliminés au départ, on peut donc attribuer l'origine de la différence à la nature des canalisations et aux propriétés agressives de l'eau potable.

Le travail a montré, comme le précédent, qu'environ 50% d'un échantillon aléatoire d'habitations de Verviers était encore pourvu de canalisations en plomb malgré le danger représenté par ce matériau. On peut en déduire que 50% de la population de la ville reste exposée à un risque toxique dont l'importance quantitative ne s'avère cependant pas alarmante.

On a également étudié la répartition statistique des plombémies et l'influence de quelques variables classiques : l'âge, le sexe, le temps de résidence à la même adresse et l'usage de la cigarette. L'influence des trois premières variables est démontrée.

L'existence d'une entité géographique et administrative restreinte, de niveau de vie élevé, dont les habitants ont une plombémie deux fois plus élevée que la moyenne régionale pourrait avoir des conséquences discrètes sur la mortalité, la morbidité ou tout autre indice de santé publique. Etant donné l'importance numérique de la population étudiée et de la population témoin, de même que la durée d'exposition au risque, une étude épidémiologique appropriée de la mortalité est en cours afin de démontrer les conséquences possibles du doublement de la charge corporelle en plomb, quelle que soit l'origine de ce toxique.

LEAD CONCENTRATIONS IN DRINKING WATER AND BLOOD LEAD LEVELS IN AN ADULT POPULATION

J. DE GRAEVE, P. JAMIN, D. RONDIA

**Université de Liège et
Centre de transfusion sanguine de Verviers, Belgium**

ABSTRACT- The total lead body burden depends mainly on lead compounds entering the body by two routes:

1. - Bronchi and alveoli, by which particles and fumes from motor vehicle exhaust gases enter the body.

2. - The digestive tract, by which alimentary lead enters the body. This lead originates in the soil where the food was produced, the container in which the food was stored or, in the case of some children, substances habitually put in the mouth.

Previous work carried out in an area of Eastern Belgium had shown that in a town of approximately 35,000 inhabitants, the aggressiveness of the drinking water caused a slow dissolution of the lead pipes which still carry water to some 50% of dwellings in the town.

The concentration of lead in this water varied from 1 to 1.5 mg/l. When non-lead pipes were used, the concentration of this metal did not exceed 0.15 mg/l.

In the suburbs of this same town, the drinking water is hard or artificially hardened, and the concentrations of lead were generally lower than 0.03 mg/l, irrespective of the material used for piping.

Since the concentration of lead in the blood is a relatively faithful indicator of the total lead body burden, and this concentration is easily measurable to a satisfactory degree of accuracy, it was found useful to study the effects on a broad section of the adult population of the constant absorption of lead into the organism in small daily doses over a period of several years.

Studies were carried out on approximately 1200 blood donors of both sexes aged from 20 to 65 years, living in the Verviers region. They were divided into four groups according to the kind of drinking water they used and the type of piping:

Group 1: soft water with lead pipes.

./.

Group 2: soft water with non-lead pipes.

Group 3: hard water with lead pipes.

Group 4: hard water with non-lead pipes.

The results of the survey are highly significant. They show that the section of the population at risk (Group 1) has a blood lead level twice as high as the rest of the sample whose level corresponds to the commonly accepted norm (Group 1: 26.9 µg/100 ml, Group 3: 14.9 µg/100 ml, Group 4: 13.3 µg/100 ml). Since air pollution, dietary habits, and the socioeconomic level of the different groups were in all cases equivalent, occupational factors having been eliminated from the outset, the difference noted can be attributed to the type of pipes used and the aggressive properties of the drinking water.

This survey, like previous work, showed that approximately 50% of a random sample of homes in Verviers still had lead pipes, despite the known dangers of this material. It can thus be deduced that 50% of the town's population is still exposed to a toxic risk which has not, however, reached alarming proportions.

The statistical distribution of blood lead levels was also studied, along with the effects of some conventional variables: age, sex, time of residence at the same address and cigarette smoking. The effects of the first three variables were established.

The existence of a restricted geographical and administrative entity, with a high standard of living, whose inhabitants have a blood lead level twice as high as the regional average could affect - if unobtrusively - mortality, morbidity or any other public health index. In view of the numbers studied and the size of the control population, as well as the period during which they are exposed to risk, an epidemiological study of the mortality figures is now being undertaken in order to establish the possible consequences of a doubling of the lead body burden, from whatever source.

INCREASED SUSCEPTIBILITY OF FEMALES TO INORGANIC LEAD

E. J. STUIK and R. L. ZIELHUIS

Coronel Laboratory, University of Amsterdam, The Netherlands

ABSTRACT - In a volunteer study in adult males and females with oral administration of Pb, females responded with increase of protoporphyrin in erythrocytes at significantly lower levels of Pb in blood. Epidemiological studies have started to examine this phenomenon in field studies. The possible significance for public health will be discussed.

CLINICAL AND ENVIRONMENTAL CORRELATIONS WITH BLOOD LEAD LEVELS OF CHILDREN IN NEW YORK CITY

VINCENT F. GUINEE, BERNARD DAVIDOW, ALEX TYTUN

New York City Health Department-Bureau of Lead
Poisoning Control, New York City, U.S.A.

ABSTRACT - During the three year period, 1970-1972, the New York City Health Department-Bureau of Lead Poisoning Control performed over 300,000 blood lead determinations on approximately 265,000 children. This included 23% of all children age 1-6 years in the city.

Parents of children with blood lead levels of 60 micrograms per 100 mil. or higher were visited at home by a Public Health Nurse. As part of this interview questions were posed concerning any symptoms which the child had in the recent past which could be attributed to the effects of lead.

Data were analyzed by specific symptoms, blood lead level and year of age. The percentage of children with symptoms increased with the increase of blood lead level. However, approximately 50% of each age group had no symptoms according to the mothers' responses at the time of the interview. As might be expected gastrointestinal symptoms were the most common. Severe neurological symptoms such as convulsions and coma were relatively rare.

To analyze the relationship between the blood lead levels in young children living in low socioeconomic areas of New York City and the degree of lead paint exposure in their housing, indices of housing deterioration were constructed. For each of these indices, a gradient of increasing deterioration with increasing blood lead level was noted.

MORTALITY IN WORKERS IN LEAD SMELTERS AND LEAD BATTERY PLANTS

W. CLARK COOPER and WILLIAM R. GAFFEY

Tabershaw-Cooper Associates, Berkeley, California, U.S.A.

ABSTRACT - The authors report an epidemiologic study of workers in lead smelters and lead battery plants, supported by the International Lead and Zinc Research Organization, Inc. the purpose of which was to determine mortality patterns. Of 84 plants in the United States that agreed to participate, 16 were selected for study. In these, 7,032 male workers who had worked for one year or more between January 1, 1956 and December 31, 1970 were identified; 2,993 had worked for over 10 years and 1,788 for over 20 years. Of these 96% were located by follow-up. Causes of death, based on 1,267 deaths, analyzed in relation to general population statistics and internally in terms of duration and nature of exposures to lead. The latter includes consideration of data on blood and urinary lead determinations in 2,995 workers.

EVALUATION OF LONG-TERM EFFECTS OF ELEVATED BLOOD LEAD CONCENTRATIONS IN ASYMPTOMATIC CHILDREN

JAMES L.McNEIL, J.A. PTASNIK

Texas Tech University School of Medicine
El Paso, Texas , U.S.A.

ABSTRACT - The primary problem of childhood lead poisoning in the United States has been almost exclusively confined to the pica inclined pre-school child living in deteriorated pre-1940 housing containing flaking lead paint in a situation compounded by parent-child emotional or economic inadequacy. Cases of overt clinical lead toxicity have resulted in such children. However, in addition, there exists a significant number of children with elevated blood lead concentrations in the 40 - 80 µg/100G range who show no symptoms of lead intoxication. It has been suggested that sustained increased body lead burden as reflected by such blood lead concentrations may result in permanent deleterious effects in children. If so, elevations of blood lead concentrations from all sources of exposure are, in fact, deleterious and the severity and magnitude of plumbism is much more severe than presently thought. The current study is an attempt to provide information on possible long-term deleterious effects of lead exposure in children with increased body lead burden but without clinical symptoms of lead poisoning.

In January, 1972, a situation was discovered in El Paso, Texas which represented an opportunity to study the possible long-term deleterious effects of lead in a well-defined human population. An isolated community, Smeltertown, adjacent to a large non-ferrous metals smelter in operation for 81 years, was found to be highly contaminated with lead. An estimated 176 children resided there and of these, 138 have been included in this study. 70% have blood lead concentrations between 40 and 80 µg/100G. 54 children are under age 7 and 84 are over age 7. There have been no history of encephalopathy nor other overt clinical symptoms of lead poisoning in the area.

High lead content paint was minimal. The sources of lead were presumed to be ambient air and contaminated soil from the smelter. Environmental conditions, consistent plant operations, and serial blood lead determinations over a period of two years suggest that this group

./.

of children has sustained asymptomatic elevations in lead body burden.

Control groups were chosen from children residing outside of Smeltertown who were matched with those in Smeltertown by age, sex, race, and family income. A second control group of pre-school age children was obtained from a rural community approximately 12 miles from the smelter. All children were evaluated on a blind basis by examiners who were given only a study number, first name, and age for each child. All children received a subjective history questionnaire obtained from their parents, a complete physical and neurological examination, and a laboratory battery including blood lead determinations, blood smear, hemoglobin, hematocrit, SMA-14, determination of free erythrocytic protoporphyrin, and urinalysis. X-rays of the hands and wrist were made for computer analysis of bone weight, density, and size in order to determine the chronicity of the lead exposure. A complete psychometric examination of each child has also been carried out using a variety of tests.

A report on the findings of this study will be presented. In particular, the following points will be discussed:

a) The chronicity of lead exposure and resultant body lead burden.

b) A comparison of psychometric, neurological and clinical data obtained from control children versus lead exposed children.

These results will assist in determining if current guidelines for a safe blood lead concentration in children are adequate for safety.

UNTERSUCHUNGEN UEBER DEN ZUSAMMENHANG ZWISCHEN DEM BLUTBLEISPIEGEL BEI NEUGEBORENEN IM RUHRGEBIET UND DER BLEIIMMISSIONSBELASTUNG DER MUETTER AM WOHNORT.

J. HOWER, B. PRINZ, E. GONO, G. REUSSMANN

Aus der Kinderklinik und dem Hygiene Institut der Gesamthochschule Essen,
43 Essen, Hufelandstr. 55 und der Landesanstalt für Immissions- u. Bodennutzungsschutz, 43 Essen, Wollneyer Str. 6
B.R.D.

KURZFASSUNG - In Nordrhein-Westfalen wurde ein Wirkungskataster über eine Fläche von etwa 800 km^2 zur Beurteilung von Luftverunreinigungen erstellt. Hierbei wurde unter anderem erstmals ein standardisiertes Graskulturverfahren zur Messung der Bleibelastung verwandt. Da sich die überwachte Fläche über einen Teil des westlichen Ruhrgebietes erstreckte, ergaben sich erhebliche Unterschiede in den Messergebnissen.

In Zusammenarbeit der Kinderklinik und des Hygiene Institutes der Gesamthochschule Essen, sowie der Landesanstalt für Immissions- und Bodennutzungsschutz des Landes NW, wurden die bereits vorliegenden Untersuchungen im Hinblick auf die Bleibelastung von reifen und unreifen Neugeborenen in Abhängigkeit von der Immissionsbelastung am Wohnort der Mutter erweitert.

Hierbei fanden sich folgende Ergebnisse:

1) Die schon in der Literatur diskutierte Abhängigkeit zwischen mütterlichem und kindlichem Blutbleispiegel wurde bestätigt.

2) Mit ansteigendem Geburtsgewicht der Frühgeborenen wurde ein Anstieg des mittleren Bleispiegels im Blut beobachtet.

3) Eine Abhängigkeit der Frühgeburtenhäufigkeit von der Bleibelastung konnte nicht nachgewiesen werden.

4) Die Untersuchung ein- und zweieiiger Zwillinge ergab fast identische Blutbleiwerte.

5) Unsere bisherigen Ergebnisse deuten auf eine Beziehung zwischen der Bleiaufnahme in Gräsern und der foetalen Bleibelastung am Wohnort der Mutter hin.

INVESTIGATIONS INTO THE RELATION BETWEEN THE BLOOD-LEAD LEVELS OF NEW-BORN BABIES IN THE RUHR AND THE LEAD BODY BURDEN OF MOTHERS AT THEIR DOMICILE

J. HOWER, B. PRINZ, E. GONO, G. REUSSMANN

Kinderklinik und Hygiene Institut der Gesamthochschule und Landesanstalt für Immissions- und Bodennutzungsschutz, Essen, Federal Republic of Germay

---

ABSTRACT - In Nordrhein-Westfalen, an area of approximately 800 km^2, was selected for a survey on atmospheric pollution. One of the initial experiments was a standardized grass-growing experiment in order to measure the lead burden. Since this area extended over a large part of the Western Ruhr district the results varied considerably. In collaboration with the "Kinderklinik" and the "Hygiene Institut der Gesamthochschule Essen," and also the "Landesanstalt für Immissions- und Bodennutzungsschutz des Landes NW," the investigations which were already in hand on the lead body burden of fully developed and premature babies as a function of the degree of pollution at the mothers domicile were extended.

The following results were obtained:

1) The correlation between blood-lead levels in the mother and the child, which has already been discussed in the literature, was confirmed.

2) A direct correlation between the birth weight of the premature child and the mean blood-lead level was observed.

3) There was no evidence of a correlation between the incidence of premature births and lead pollution.

4) An examination of monozygotic and bizygotic twins showed almost identical blood-lead levels.

5) Results obtained so far indicate a connection between the lead uptake of grass and the lead body burden in the foetus at the mother's domicile.

INFLUENCE DE L'EXPOSITION AUX GAZ D'ECHAPPEMENT AUTOMOBILES SUR L'IMPREGNATION PAR LE PLOMB DE DIFFERENTS GROUPES DE POPULATION

C. BOUDENE, J. MEININGER, F. ARSAC, J. GODIN

I.N.S.E.R.M. U 122 - Université Paris-Sud, Chatenay-Malabry, France

---

RESUME - Dans le but de mesurer l'influence éventuelle du plomb contenu dans les gaz d'échappement automobiles, 3 groupes de population très différemment exposés ont été soumis à la détermination de la plombémie et de l'activité ALA D érythrocytaire.

Le premier groupe (I) correspond à une population essentiellement rurale (teneur moyenne en plomb de l'air voisine de 0,3 μg/m^3).

Les deux autres groupes étudiés correspondent à une population urbaine.

L'un (II) est constitué de sujets vivants à Paris ou dans sa proche banlieue mais n'étant pas soumis à des conditions d'exposition aux gaz d'échappement spécialement défavorables.

L'autre (III), par contre, comprend des chauffeurs de taxis parisiens soumis durant leur travail de 10 heures par jour à une concentration atmosphérique moyenne de plomb d'environ 3 μg/m^3.

Si la plombémie et l'activité ALA D sont assez voisines pour les groupes I et II, elles présentent par contre des différences significatives entre les groupes I et III.

Dans tous les cas, une corrélation négative significative Plombémie / ALA D a été observée.

THE INFLUENCE OF EXPOSURE TO AUTOMOBILE EXHAUST GASES ON THE LEAD CONCENTRATION IN DIFFERENT POPULATION GROUPS

C. BOUDENE, J. MEININGER, F. ARSAC, J. GODIN

Laboratory of Toxicology U.E.R. of Hygiene and of the Protection of Man and his Environment, University PARIS-SUD, Chatenay-Malabry, France

---

ABSTRACT - With a view to measuring the influence, if any, of the lead present in automobile exhaust gases, three very differently exposed population groups were subjected to tests to determine blood-lead level and ALA D activity of the red corpuscles.

The first group (I) represents an essentially rural population (average lead concentration of ambient air 0.3 $\mu g/m^3$.)

The other two groups studied represent an urban population.

One of these (II) is composed of test subjects living in Paris or its near suburbs and not subject to particularly unfavourable exposure to exhaust gases.

The third group (III), on the other hand, comprises Paris taxi drivers who are subjected during their 10-hour working day to an average atmospheric lead concentration of about 3 $\mu g/m^3$.

Whereas the blood-lead level and ALA D activitiy are fairly closely related in groups I and II, they show significant differences between groups I and III.

In every case a significant negative correlation was observed between blood-lead level and ALA D.

INVESTIGATIONS OF THE ABSORPTION OF SOME METALS AMONG PEOPLE IN THE SURROUNDING AREA OF A SMELTING PLANT

IVAR HOLMQVIST

Medical Department Boliden Co., Rönnskär,
Sweden

ABSTRACT - The investigation was carried out in order to show to what extent emission of metals from a smelting plant, Boliden Aktiebolag, Rönnskär, in the north of Sweden, could be found in blood and urine among people in the surrounding area and if any biological effects of the emission could be observed.

Analyses of metals in urine have been made on 3 groups of women living at different distances and in various directions from the smelting plant. Arsenic, lead, cadmium and mercury contents have been tested. The analyses do not show any unnormally high percentages of those metals in the urine in any of the groups. Regarding arsenic some differences between the groups could be noted owing to meteorological factors. As for lead, cadmium and mercury low contents were found and any differences between the various regions could not be shown. Considering a possible cadmium exposure a test was made to find out if tubular protein in urine could be found. This could not be found neither in cadmium exposed workers of the smelting plant nor in women in the surrounding area. The emission of metals from the smelting plant do not seem to give people in the surrounding area any content of metals in urine that could indicate any risk at all.

Lead determinations in blood showed a somewhat higher mean value in men who lived in the immediate neighbourhood of the smelting plant (N = 154, range = 5-36 μg/100 ml, M = 13.6 μg/100 ml) than in those who lived further away from the plant. Students had a significant lower value (N = 369, range = 4-40 μg/100 ml, M = 11.3 μg/100 ml) than occupational men (N = 432, range = 4-62 μg/100 ml, M = 13.5 μg/100 ml). Among the workers the metal workers had the highest mean value (15.9 μg/100 ml) and workers at board and pulp industry had the lowest (11.9 μg/100 ml). Students at trade schools had significant higher values than other categories of students. Trade school students: N = 49, range 5-23 μg/100 ml. M = 11.8.

./.

Other students: N = 163, range = 4-40 ug/100 ml, M = 10.40.

The difference was significant at the level of 5%.

Profession seems to be of more importance for lead content in blood than distance to the smelting plant. Age seems to be of no importance, the determining factor for lead content in blood among workers is the exposure.

Differences in the ALA content in urine could not be found between the groups mentioned above even though the difference of content of lead in blood amounted to 8.8 µg/100 ml. The ALA values stayed in general around 0.30 mg% in all groups without significant differences.

64

STUDY ON CADMIUM PROTEINURIA. GLOMERULAR DYSFUNCTION : AN EARLY SIGN OF RENAL IMPAIRMENT

H. ROELS, R. LAUWERYS, J.P. BUCHET

Unité de Toxicologie Industrielle et Médicale,
Université Catholique de Louvain, Brussel, Belgium

ABSTRACT - Recently, a few articles dealing with cadmium-induced proteinuria in man (1) and rabbits (2), and with a renal dysfunction, viz. Balkan nephrophathy (3), which shows a proteinuria with an electrophoretic pattern closely related to the former (4), gave support to the assumption that a glomerular dysfunction may be an early phase in cadmium-induced renal impairment.

Our previous conclusion (1) has been based only on the electrophoretic pattern of urinary proteins obtained from clinically healthy workers, who were moderately exposed to cadmium for less (Ni-Cd storage battery factory) and more (cadmium producing plant) than 20 years. The former group showed only glomerular type proteinuria, the latter glomerular and mixed (glomerular + tubular) proteinuria. Further investigations were carried out in order to clarify the relative importance of glomerular and tubular proteinuria in terms of renal clearance ratios, i.e. albumin, ribonuclease or lysozyme/creatinine.

The study population consisted of male workers from two different cadmium producing plants who were moderately exposed to Cd-dust (plant I, 60 workers with less than 20 years exposure, and 3 with more than 20 years exposure; plant II, 13 workers all with more than 20 years exposure). The workers exposed to Cd were apparently in good clinical condition. Matched control groups of workers not exposed to Cd were also examined.

The following biological parameters were measured on serum and urine samples : albumin, lysozyme, ribonuclease, and creatinine. Determination of total proteinuria, electrophoresis of urinary proteins, determination of amino-aciduria and of Cd in blood and in urine were also carried out.

The results obtained for the exposed workers in the two factories were combined. An abnormal electrophoretic pattern of urinary proteins was found in 5 workers out of 60 with less than 20 years exposure, and in 13 out of 16 with more than 20 years exposure. In the former group 4 cases were classified by electrophoresis and clearance ratio as glomerubar and 1 as mixed proteinuria. In the latter group 5 cases were classified electrophoretically

./.

as glomerular and 8 as mixed proteinuria, but on the basis of clearance data we found more glomerular than mixed proteinuria. The electroforetic classification is rather difficult when proteinuria is only slightly increased. The workers exposed for more than 20 years showed all a moderate and statistically significant decrease in albuminemia and only in two cases, classified as mixed proteinuria by electrophoresis and clearance data, the aminoaciduria was slightly higher than the control values.

These results tend again to confirm that in the early stage of cadmium intoxication the glomerular dysfunction precedes the tubulopathy which is only found in workers highly exposed to cadmium and excreting more than 1 g of protein daily (5).

1. R. LAUWERYS, J.P. BUCHET, H. ROELS, J. BROUWERS and D. STANESCU. Accepted for publication in Arch. Environ. Health.

2. K. NOMIYAMA, C. SATO and A. YAMAMOTO, Toxicol. Appl. Pharmacol., 24 (1973) 625-635.

3. Lancet, 1973, i, 472.

4. P. HALL, M. PISCATOR, M. VASILJEVIC and N. POPOVIC, Quat. J. Med., 41 (1972) 385-393.

5. M. PISCATOR, Arch. Environ. Health 12 (1966) 335-344.

ACKNOWLEDGMENT

This work was supported by the Commission des Communautés Européennes. Project CECA, n° 6244 - 00/2/028

THE CONCEPT OF ESTIMATION OF AN ACCEPTABLE DAILY INTAKE FOR MAN OF FOOD ADDITIVES AND PESTICIDES

E. POULSEN

National Food Institute, Institute of Toxicology, 2860 Søborg, Denmark

---

ABSTRACT - In the assessment of the health effects in man of pesticides and food additives by far the best information would be obtained from investigations in man. There may, however, be serious ethical and legal problems in connection with investigations designed to establish safety or to detect toxicity in man. Useful information may sometimes be derived from studies on persons who are occupationally exposed to the chemical or who have been accidentally poisoned by it. In some cases the exposed population may be large enough and sufficiently well defined to render appropriate epidemiological studies worthwhile.

In most cases, at present, the assessment of the health effects and the safety for man of exposure to food additives and pesticides must be based on results of animal experiments. As the major route of exposure for the general population to these chemicals is through food an assessment of the significance for health is based on the intake via food and drinking water.

The FAO/WHO Expert Committees on Food Additives and Pesticides Residues are estimating the Acceptable Daily Intake (ADI) for Man of many food additives and pesticides. It is understood that the intake of an amount of the chemical in question corresponding to the ADI would be without appreciially health effect in man, even if the intake continued through the entire lifetime of the individual. A short period of excess intake would not be expected to affect the health of the person as the ADI is usually estimated at a level much below the level of any effects on health.

When estimating an acceptable daily intake for man the most important information is the results of investigations in man, if any are available. Furthermore the main emphasis is placed upon information from biochemical studies on the effect on components of the animal organism (mechanism of toxic action) and on the uptake, fate and elimination of the compound. Imperative are results of studies from which the long-term hazard of the compound can be best possible assessed e.g. long-term animal studies on chronic toxicity, carcinogenicity etc.; relevant studies on the mutagenic or teratogenic potential and studies on the effect on reproduction are also important. In the estimation of an acceptable daily intake all the available information - published or unpublished - is used. Due to the difficulties in extrapolation from the results of animal experiments to problems of safety and health of man, great caution is usually exercised and wide margins of safety are included.

When more knowledge is obtained - through research - on the possibility of estimating subtle changes in biochemical, neurophysiological and behavioural parameters in man and when the significance of such changes is established, a supplementary approach to the present safety assessment may be achieved.

./.

For the time being there seems to be no realistic alternative to the concept of the acceptable daily intake for man if an assessment is attempted of the safety and the possible health hazards of the intake of food additives and pesticide residues.

ETUDE PREPARATOIRE EN VUE DE L'ETABLISSEMENT D'UN PROGRAMME COORDONNE DE SURVEILLANCE DE LA CONTAMINATION DE L'HOMME PAR LES PRODUITS CHIMIQUES

E. FOURNIER

Faculté de Médecine LARIBOISIERE - Saint-Louis, Université Paris VII
Unité de Toxicologie Expérimentale - I.N.S.E.R.M.
200, rue du Faubourg Saint-Denis, 75010 Paris

RESUME - Le projet H.M.P. s'efforce d'étudier les intoxications subchroniques et chroniques liées à l'environnement chimique moderne, les intoxications aiguës étant étudiées par ailleurs.

Le projet doit porter sur des observations de très longue durée à forte dispersion écologique, donc difficiles et coûteuses. C'est cependant le seul moyen de définir des paramètres de surveillance et de valider des observations cliniques réparties au hasard.

Le projet comprend la surveillance régulière d'échantillons de population représentatifs d'un ensemble suffisant, la surveillance spécifique de certaines populations particulièrement exposées ou particulièrement sensibles : étude professionnelle, pharmacovigilance, groupes humains sentinelles en particulier allergiques.

Une banque de données toxicologiques par collecte aléatoire est une organisation indispensable à la recherche des coïncidences suspectes. Elle participe à la coordination d'un projet qui tend à répondre aux inquiétudes manifestées devant le "danger chimique" par l'ensemble des populations à civilisation industrialisée.

PRELIMINARY STUDY FOR A HUMAN MONITORING PROGRAMME IN CLINICAL TOXICOLOGY

E. FOURNIER

Faculté de Médecine LARIBOISIERE-Saint-Louis
Université Paris VII, Unité de Toxicologie Expérimentale - I.N.S.E.R.M.
200, rue du Faubourg Saint-Denis, 75010 Paris, France

ABSTRACT - The HMP is aimed at studying chronic and sub-chronic poisoning caused by the chemicals in the modern environment, acute poisoning being dealt with in another study.

The project must be based on observations over a very long period and with a wide ecological distribution, and so they will be difficult and expensive. This is, however, the only way of defining surveillance parameters and of validating random clinical observations.

The project involves the regular surveillance of population samples representative of an adequate total population, as well as specific surveillance of certain groups which are particularly exposed or particularly sensitive: professional studies, pharmacological control, pilot groups of people - particularly those with allergies.

A bank of toxicological data obtained by random sampling is indispensable for research into suspicious coincidences. This data bank will help to coordinate a project which reflects the disquiet about the "chemical danger" felt by all people in industrialised countries.

METHODOLOGIE POUR L'EVALUATION DE L'EXPOSITION DE L'HOMME RESULTANT DE LA CONTAMINATION DES ALIMENTS PAR LES METAUX LOURDS.

ETUDE DE QUELQUES CAS CONCRETS.

R. BITTEL, A. GARNIER, G. LACOURLY

Association EURATOM-CEA, Niveau de pollution du milieu ambiant,
Département de Protection, Service de Protection Sanitaire,
Fontenay aux Roses - France

RESUME - Dans le cadre d'une Association entre les Communautés Européennes et le CEA, une méthodologie, inspirée par les recherches antérieures dans le domaine radioactif, a été mise au point en vue d'évaluer, dans toute situation, les quantités de métaux lourds ingérées par l'homme en fonction des niveaux dans le milieu, des régimes alimentaires et des caractéristiques des transferts, en tenant compte des concentrations et des dilutions qui peuvent intervenir lors des différents stades du transfert : production, transformation et distribution des aliments. La même méthodologie permet, inversement, de déterminer, dans chaque cas, la capacité limite du milieu. Compte tenu de la complexité des différents paramètres intervenant dans les transferts, des études de sensibilité apparaissent indispensables pour définir les recherches à entreprendre en priorité.

Pour concrétiser les conceptions précédentes, on a appliqué cette méthodologie aux transferts des métaux lourds (Hg, Cd, Pb, Cu, Zn, en particulier) dans des chaînes alimentaires aquatiques et continentales.

METHODOLOGY FOR THE EVALUATION OF THE EXPOSURE OF MAN RESULTING FROM THE CONTAMINATION OF FOOD BY HEAVY METALS. STUDY OF SOME CONCRETE CASES

R. BITTEL, A. GARNIER, G. LACOURLY

Association Euratom-CEA, Level of Environmental Pollution,
Protection Department, Health Physics Service
Fontenay-aux-Roses, France

ABSTRACT - On the basis of previous research in the radioactive sphere, a methodology has been developed by an Association of the European Communities and the CEA, with a view to evaluating quantitatively in any given situation, the heavy metals ingested by man, as a function of levels in the environment, diet, and transfer characteristics, and taking into account concentrations and dilutions which may occur at the different transfer stages viz. production, processing and distribution of foodstuffs. Conversely, the same methodology can be used to determine, in each case, the limiting capacity of the environment. Given the complexity of the different parameters occurring during transfer processes, sensitivity studies appear to be essential, in order to define which research should be given priority.

In order to make the previous ideas more concrete, this methodology was applied to the transfer of the heavy metals (especially Hg, Cd, Pb, Cu, and Zn) in the food chains, both in water and in the soil.

STUDIO DELLE POSSIBILI VIE DI TRASFERIMENTO DEL MERCURIO DALL'AMBIENTE ALL'UOMO E DELLA SUA PRESENZA "IN VIVO" NELLA POPOLAZIONE DELLA ZONA MERCURIFERA DEL MONTE AMIATA

P. CAGNETTI, L. CIGNA ROSSI, G.F. CLEMENTE, G.P. SANTARONI

Laboratorio radioattività ambientale - CNEN - Roma (Italia)

RIASSUNTO - Nell'ambito della ricerca sulla diffusione del mercurio in un'area particolarmente ricca di minerali mercuriferi trattati industrialmente "in loco" sono state esaminate le possibili vie de trasferimento del mercurio all'uomo in una zona appositamente selezionata nella regione del M. Amiata. E' stato infatti trovato precedentemente che tale zona, sia per la sua densità di popolazione sia per il fatto di essere esposta agli scarichi industriali di uno dei principali centri di sfruttamento industriale del minerale mercurifero, può essere considerata particolarmente significativa.

Dopo avere studiato in un precedente lavoro il contributo dovuto ai singoli alimenti, vengono ora presi in considerazione i contributi dovuti alla dieta totale e all'inalazione.

Sono stati quindi discussi e confrontati i risultati ottenuti con le misure dei campioni rappresentativi delle due possibili vie di contaminazione della popolazione, inalazione e ingestione, calcolandone i rispettivi contributi medi.

Sono state inoltre misurate la concentrazione di alcuni tessuti e l'escrezione di mercurio da parte di individui appartenenti ad alcuni gruppi di popolazione esposti a rischi diversi di contaminazione. I livelli di mercurio sono stati determinati in numerosi campioni individuali di sangue, capelli, urine, feci e diete totali.

Sono state quindi effettuate correlazioni tra le concentrazioni di mercurio misurate nei vari campioni biologici prelevati in vivo e le quantità introdotte negli organismi sia per via aerea che alimentare al fine di stabilire un rapporto tra il livello di contaminazione ambientale e quelle in uomo.

Tutte le analisi per il mercurio sono state effettuate mediante attivazione neutronica non distruttiva.

A STUDY OF THE WAYS BY WHICH MERCURY MAY BE TRANSFERRED FROM THE ENVIRONMENT TO MAN AND OF ITS PRESENCE "IN VIVO" IN THE POPULATION OF THE MONTE AMIATA MERCURIFEROUS ZONE

P. CAGNETTI, L. CIGNA ROSSI, G.F. CLEMENTE, G.P. SANTARONI

Laboratorio radioattivita ambientale CNEN-Roma (Italy)

ABSTRACT - As part of the research into the distribution of mercury in an area particularly rich in mercuriferous ores which are processed industrially on the spot, a study was made of the ways in which mercury might be transferred to Man in a suitable zone selected in the Monte Amiata region. It had previously been found that this zone could be considered particularly significant because of both its population density and the fact that it is exposed to the industrial waste of one of the main centres for the exploitation of mercuriferous ore.

The part played by the individual foodstuffs having been examined in a previous study, present work considers the part played by overall diet and inhalation.

The results obtained from measurements of the representative samples for the two possible ways in which the population might be contaminated (inhalation and ingestion) were discussed and compared, and the corresponding mean contributions calculated.

Other parameters measured were the mercury concentrations in some tissues and in the excretions of individuals from different population groups exposed to varying risks of contamination. Mercury levels were measured in a large number of samples of blood, hair, urine, faeces and total diets.

The mercury concentrations found in the various biological samples taken "in vivo" were correlated with the quantities entering the organism in the air inhaled and the food eaten, so as to establish a relationship between the contamination level of the environment and that of Man.

All the mercury analysis was done by non-destructive neutron activation.

ACCUMULATION AND RELEASE OF PETROLEUM HYDROCARBONS BY EDIBLE MARINE ANIMALS

J.W. ANDERSON, J.M. NEFF

Department of Biology, Texas A&M University, College Station, Texas USA

ABSTRACT - Pollution of the marine environment by petroleum and petroleum hydrocarbons may pose certain health hazards to man. The tendency of marine organisms to accumulate petroleum hydrocarbons from sea water and to retain them in their tissues suggests a potential but as yet unassessed health hazard to consumers of marine fish and shellfish. To better understand this problem, we have conducted a series of experiments dealing with the patterns of uptake and retention of potentially toxic and/or carcinogenic petroleum hydrocarbons by several species of marine crustacea, molluscs and fish.

Two crude oils, South Louisiana and Kuwait, and two refined oils, #2 Fuel Oil and Venezuelan Bunker C residual oil, were used in these experiments. Oil-in-water dispersions and water-soluble fractions prepared from these oils differed greatly in both qualitative and quantitative hydrocarbon composition. Sea water mixtures prepared from the refined oils contained substantially higher concentrations of di- and tri-aromatic hydrocarbons than did those prepared from the crude oils. However the qualitative pattern of petroleum hydrocarbon uptake and retention was similar when organisms were exposed to oil-water mixtures of the four test oils. The naphthalenes as a group were the hydrocarbons accumulated to the greatest extent by all marine animals exposed to the test solutions. When oil-exposed animals were returned to oil-free sea water, they rapidly released the accumulated petroleum hydrocarbons from their tissues. Saturated hydrocarbons were released more rapidly than the aromatic hydrocarbons. In most cases the di- and tri-methylnaphthalenes were the last petroleum hydrocarbons to reach undetectable concentrations in the tissues. Complete release of petroleum hydrocarbons from the animals occured in from one to 52 days, the rate being species dependent. Generally, crustaceans and fish released the accumulated hydrocarbons more rapidly than did molluscs.

During these investigations a simple, rapid spectrophotometric method was developed for the quantitative determination of naphthalene and alkyl naphthalenes in the tissues of marine animals. This technique is now being evaluated as a means of rapidly determining the degree of petroleum contamination of fish and shellfish.

The results of these investigations will be discussed in relation to the hazards to human health resulting from the ingestion of marine animals contaminated with petroleum hydrocarbons as a result of oil spills.

RECAPITULATION OF ENVIRONMENTAL EXPOSURES

THOMAS D. ENGLISH

EPA, National Environmental Research Center
Research Triangle Park, North Carolina 27711-U.S.A.

ABSTRACT - In order to quantitate the effects of air pollutant exposure on diseases such as chronic respiratory disease, annual estimates of air pollutant concentrations for approximately twenty years are required. This paper describes general techniques for the recapitulation of environmental exposure under a wide variety of topographic, climatic atmospheric stability conditions are analytically coupled with source emission data to estimate past spatial distributions of various pollutants.

Example recapitulations of sulfur dioxide concentrations and total suspended particulate concentrations are presented for both densely populated areas such as Metropolitan New York, and sparsely populated areas as Helena, Montana. The use of dustfall data as an indicator of other pollutants such as suspended sulfates and suspended nitrates is examined statistically. Methods are described for calibrating computer based air pollution meteorological models to local topographic and climatic conditions. Techniques for determining the limits of precision of air pollutant exposure estimates are described in detail.

Measurements of air pollutant exposure for communities in the vicinity of Los Angeles were provided by the California Air Resources Board, the Los Angeles Air Pollution Control District and the San Diego Air Pollution Control District. These measurements constitute a data base upon which estimates of air pollution concentrations for a 10,000 square mile area (the California South Coast Air Basin) are made. Annual average isoplethes for Oxidant, NO_2, and total suspended particulate are constructed for the time period from 1955 to 1972. Annual average isoplethes of the daily maximum hourly average concentrations are presented to provide estimate of the magnitude of peak air pollutant exposures. A discussion of hourly spatial distribution of Oxidant is presented. Long-term trends for 7 communities are described.

SAMPLING, ANALYSIS AND COMPOSITION OF AIRBORNE PARTICULATE MATERIAL IN BELGIUM

R. DAMS, M. DEMUYNCK

(with the technical assistance of
M. Nagels and R. Steelandt)

Institute for Nuclear Sciences - Rijksuniversiteit Gent - Belgium

ABSTRACT - During one year aerosols have been sampled at 14 industrial, urban, rural and marine locations in Belgium. Daily at each station approximately 400 m^3 of air was filtered during 24 hours on a 11 cm Whatman 41 cellulose filter. All samples were analyzed for total suspended particulate and a large number for silicon, iron, calcium, manganese, aluminum, sodium, zinc, copper, cadmium, mercury, lead, chlorine, bromine, fluorine and about 25 other metallic trace elements. A limited number was analyzed for sulphate, nitrate, ammonium, water, benzene extractable organics and the ash content. When properly summed, the measured constituents account for 50 to 75% of the total mass of the aerosol. The analytical techniques applied include instrumental activation analysis, using thermal, fast fission and 14 MeV neutrons, flameless atomic absorption, spectrophotometry and gravimetry.

Mean, maximum and most frequent values at all 14 stations for total suspended particulate matter and typical chemical compositions of the aerosols were calculated. The variations of the levels over the country and under the influence of the meteorological parameters are discussed. The generally much higher ambient air levels in industrial and urban areas, than in rural areas give first indications for the pollution origin of the aerosols sampled. Inspection of the aerosol composition and its geographical distribution as a function of wind direction clearly indicate the existence of important localized emission sources for elements such as iron, copper, zinc, cadmium, selenium, antimony, indium, silver, mercury, etc.

Intensive area-wide simultaneous samplings in industrial and urban areas reveal the existence of strong concentration gradient in the neighbhourhood of steel plants and non-ferrous industries. Measurements of the mass versus aerodynamic particle size for all elements, by means of 8 stage cascade impactors, give information on the penetration and retention in the lungs of all the components determined.

THE CHAMP AIR QUALITY MONITORING PROGRAM

*GEORGE LAUER, **FERRIS B. BENSON

*Science Center, Rockwell International Thousand Oaks
California 91360 - U.S.A.
**Health Effects Laboratory, Environmental Protection Agency,
Research Triangle Park, North Carolina 27711 - U.S.A.

ABSTRACT - The Community Health Air Monitoring Program of Health Effects Laboratory of the Environmental Protection Agency has a requirement to obtain large amounts of valid data for their studies of the effects of contaminants and particulate pollutants on the population. The CHAMP system has been constructed to provide this data by construction of field stations which are installed at various locations in the continental United States. A central computer system obtains the data via commercial telecommunications media, stores this data, and then performs a machine validation on it. Each station is equipped with an integral calibration system which permits rapid check of the instruments and calibration to a known standard for each of the sensors utilized. The methodology utilized to automatically validate the data will be described, as well as the calibration and quality control aspects of the system.

STUDIES OF TRACE SUBSTANCES IN AN URBAN ATMOSPHERE

MERRIL EISENBUD, THEO. J. KNEIP, MICHAEL KLEINMAN, DAVID BERNSTEIN

New York University Medical Center, 550 First Avenue, New York, U.S.A.

ABSTRACT - An investigation has been undertaken of certain trace substances in the atmosphere of New York City in order to: 1) improve our understanding of the seasonal and year-to-year variations in the concentrations of these substances; 2) ascertain their particle size distribution; 3) determine the extent to which human tissue burdens are due to atmospheric exposure; and 4) enable one to apportion the total suspended particulates among some of the major sources, such as space heating, power generation, ocean spray, and automobile traffic. In addition, certain characteristics of settled dust have also been studied in order to understand the relationship of settled to airborne dust and to develop methods by which the source of settled dust can be ascertained through analytical procedures. This paper summarizes the findings to date, with particular emphasis on the new methods that have been developed in the course of our study

A new heavy-duty sampler has been designed to provide larger samples for chemical and physical analysis than can be obtained ordinarily by conventional high-volume sampling. The unit operates at 20 cfm, with constant flow maintained for up to one week by means of a compensating bypass arrangement. Airborne dust is collected on glass fiber filter media and trace elements, including lead, copper, vanadium, nickel, cadmium, manganese, iron, zinc and chromium, are assayed routinely by atomic absorption spectrophotometry.

In order to understand the reason for observed seasonal and year-to-year differences in the concentration of suspended substances, it is desirable to normalize for meteorological influences that can overwhelm differences due to other factors. This has been done by means of a dispersion factor, which is the product of the depth of the mixing layer and the mean wind speed during a given period of observation. Normalizing the data in this way assists one to study the influences on ambient air quality of seasonal factors (such as space heating) or administrative actions taken to control air pollution.

The particle size composition of the atmosphere is being studied, using a high-capacity particle size classifier designed to operate continuously for one week, and consisting of four miniature cyclones that provide fractions having mass median diameters from 3.5 microns to 0.5 microns.

Mathematical relationships have been developed that permit estimates to be made of the fractions of the total suspended particulates that are associated with the principal trace substances, and which may originate from the same source. This paper describes the manner in which this has been accomplished and gives our current estimates of the percentages of the total particulates that are attributable to sources such as oil burning, automotive traffic, incineration, and natural sources.

./.

The International Commission on Radiological Protection has described models by which one can estimate the tissue burden from exposure to a given airborne concentration of trace substances. Samples of lung, pulmonary lymph nodes, blood, kidney, liver, and bone are being obtained in the course of autopsy of normal New York City residents who have died suddenly from natural or violent causes. This paper will review the conclusions that can be drawn from the data to date.

Studies of settled dust have shown that there are conspicuous differences in the behavior of the dusts with which the various trace elements are associated. For example, it has been observed that the trace metals exhibit a wide range of settling velocities, presumably due to characteristic differences in particle size.

(This research is supported in part by the Edison Electric Institute and American Petroleum Institute, and is part of a center grant from the National Institute of Environmental Health Sciences, Grant No. ES00260.)

AIR POLLUTION PROBLEMS IN LATIN AMERICA

R. HADDAD

Air Pollution Adviser, Pan American Health Organization,
Pan American Centre for Sanitary Engineering and Environmental Sciences
Lima, Peru

ABSTRACT - The Pan American Health Organization coordinates a network of Air Pollution Sampling Stations, which includes at present 84 stations in 25 cities of 14 countries. The results of 6 years of international cooperation of the Network are presented, showing actual concentrations and trends for SO_2 and particulates. A summary of the findings of several health effects oriented research developped in Chile, Mexico, Peru and other countries are also included. The differences between doses/effects relationships as measured at sea level, in comparison with those observed at high altitudes, are discussed.

SOURCES AND METABOLIC PATHWAYS OF LEAD IN NORMAL HUMANS

G.W. WETHERILL, M. RABINOWITZ, J.D. KOPPLE

University of California, Los Angeles, California, U.S.A.

ABSTRACT - Absorption, excretion, and internal distribution of lead has been studied in two normal volunteer adult male subjects, maintained under controlled diet and environment for periods of six months in a hospital metabolic unit. Stable isotopes of lead (^{204}Pb and/or ^{207}Pb) were used to isotopically label lead from food. This permitted distinction of this source from others (atmospheric and internal) as body fluids and tissues exchanged lead internally and with the external environment during the course of the experiments. Lead concentration and isotopic composition in blood, urine, feces, hair, nails, sweat, bile, gastric and pancreatic secretions, and bone were determined by mass spectrometric stable isotope dilution analysis.

It was found that the concentration of lead in the blood of these subjects can be simply related to measurable parameters such as the fraction of blood lead absorbed in the gut (6 to 9%), the daily quantity of internal lead excreted in urine, hair, and secretions into the gut (38 to 50 μg), and the characteristic (e-folding) residence time of lead in the metabolic pool of lead which exchanges rapidly with the blood (35 to 50 days). Blood lead concentrations could be predictably adjusted within the normal range of 0.14 to 0.27 μg/g by controlling the dietary or atmospheric input. Response of the blood lead concentration to removal and introduction of atmospheric exposure to lead at typical urban concentrations of 1 to 2 μg/m^3 showed that about 15 μg/day are added to the blood from this source, which therefore comprised about 1/3 of the daily intake from all sources.

These same techniques are being used to study the gastrointestinal absorption of lead as function of chemical form and the more complex absorption and distribution of lead between blood components and other internal pools on the shorter time scale of ≤ 3 days.

SUL PASSAGGIO TRANSPLACENTARE DI INSETTICIDI CLORURATI

CORA GRASSO

Istituto di Igiene dell'Università degli Studi di Firenze, Italia

RIASSUNTO - Sono stati ricercati e titolati gli insetticidi clorurati presenti in campioni di sangue prelevati a puerpere e ai rispettivi figli. I prelievi sono stati eseguiti prima che questi avessero assunto il primo pasto, naturale o artificiale, in maniera da titolare sicuramente soltanto gli insetticidi clorurati pervenuti al figlio dalla madre, escludendo totalmente l'apporto di tali sostanze nel periodo immediatamente successivo alla nascita.

Le titolazioni sono state eseguite sul sangue, in quanto esso rappresenta la via di trasporto degli insetticidi ai vari tessuti.

I campioni di sangue sono stati prelevati nella clinica Ostetrica dell'Università di Firenze e nel reparto di Pediatria dell'Ospedale di Arezzo, da donne di varia estrazione sociale, lavoro, domicilio, e dai rispettivi figli, alcuni nati a termine e sani (Firenze) e altri prematuri o affetti da qualche forma patologica (Arezzo). Complessivamente sono stati esaminati 70 campioni di sangue.

Gli insetticidi sono stati ricercati gascromatograficamente, con la seguente metodica: - estrazione degli insetticidi dal sangue con solventi; - purificazione dell'eluato in colonna di allumina; - analisi gas-cromatografica con detector a cattura di elettroni (elemento radioattivo Sr^{90}). Tutti i nostri cromatogrammi hanno presentato picchi di insetticidi clorurati. In tutti i campioni esaminati è presente il pp'DDT in quantità che arrivano oltre le 0,6 ppm, il DDD e il DDE. Gli altri insetticidi ricercati (lindano, eptacloro, eptacloro epossido, aldrin, dieldrin) sono presenti nella maggior parte dei campioni con eccezione dell'eptacloro epossido e del dieldrin, presenti rispettivamente solo in 4 e in 9 campioni.

I cromatogrammi degli insetticidi rilevati nel sangue delle madri e dei rispettivi figli sono simili qualitativamente, ma non quantitativamente, essendo sempre superiori i tassi reperiti nel sangue della madre rispetto a quelli dei figli. Risulta dunque che almeno in parte gli insetticidi presenti nel sangue della madre passano durante la gravidanza nel sangue del figlio.

Pressochè per tutti gli insetticidi, e tanto nel gruppo delle madri che in quello dei figli, i tassi medi riscontrati sono risultati superiori nei soggetti di Arezzo rispetto a quelli di Firenze.

Sono in corso altre prove per valutare l'eventuale correlazione di questo reperto con lo stato di salute dei neonati.

76

THE PASSAGE OF CHLORINATED INSECTICIDES THROUGH THE PLACENTA

CORA GRASSO

Università degli studi di Firenze, Istituto di Igiene, Firenze, Italy

ABSTRACT- The chlorinated insecticides present in samples of blood taken from puerperae and their children were investigated and identified. The samples were taken before the infants had been given their first breast or bottle feed, so as to be sure of titrating only those chlorinated insecticides which had reached the child from the mother, by totally excluding the introduction of these substances in the period immediately following birth.

The titrations were carried out on the blood, since this is the vehicle by which the insecticides reach the various tissues. The blood samples were taken at the Obstetrical Clinic of the University of Florence and in the pediatrics department of the Arezzo Hospital from women of various social categories, working women and housewives, and from their offspring, some being healthy children born at term, (Florence) and others born prematurely or with some pathological condition (Arezzo). 70 blood samples were examined in all.

The insecticides were examined by gas chromatography, the technique being as follows: - the insecticides were solvent-extracted from the blood, the eluate was purified in an alumina column, and a gas chromatography analysis was made with an electronic capture detector (radioactive element Sr^{90}). All our chromatograms showed peaks of chlorinated insecticides. In all the samples pp'DDT was present in quantities exceeding 0.6 ppm and also DDD and DDE. The other insecticides investigated (lindane, heptachlorine, heptachlorine epoxide, aldrin and dieldrin) were present in most of the samples with the exception of heptachlorine epoxide and dieldrin, which were found only in 4 and 9 samples respectively.

The chromatograms of the insecticides taken from the blood of the mothers and their children were similar in quality, but not in quantity, the counts found in the mothers' blood being in each case higher than those for the children. This shows that to some extent at least the insecticides in the mother's blood pass into the child's blood during pregnancy.

The average count of nearly all the insecticides , in the mothers as well as in the children, were higher for the subjects from Arezzo than for those from Florence.

Further tests are in hand to see whether these results can be correlated with the state of health of the newborn children.

77

MODIFICATION OF THE HOMOLOGUE AND ISOMER COMPOSITION OF A POLYCHLORINATED BIPHENYL MIXTURE DURING PASSAGE THROUGH TWO BIOLOGICAL SYSTEMS.

B. BUSH, F.D. BAKER, FA-CHUN LO, C.E. TUMASONIS

New York State Department of Health, Albany, N.Y., U.S.A.

ABSTRACT - The polychlorinated biphenyl (PCB) mixture Aroclor 1254 was administered to breeding populations of hens and rats at 6.3 mg/kg body weight for six weeks. The populations were then observed during the subsequent 20 week clearance period. Egg yolks and tissues of adults, embryos and foetuses, chicks and pups were analyzed and the fate of 16 individual homologs and isomers of Aroclor 1254 were observed during the buildup and decline periods. The toxicity of the PCB mixture in the hen can be attributed to either a metabolite of 3,4,2',3',6'-pentachlorobiphenyl or to the intrinsic toxicity of the more persistent 3,4,2',4',5'-pentachlorobiphenyl or 2,3,4,2',4',5'-hexachlorobiphenyl. In the rat, however, both of the above pentachlorobiphenyls were eliminated relatively rapidly. Hence, 4,4'-substitution is more in determining persistence in the chicken than in the rat.

Analyses of rat foetuses showed that there was little placental transfer of PCB. However PCB was passed from mothers to pups as soon as suckling began. By contrast, the chick embryo was exposed to PCB present in egg yolk from its earliest development.

Analyses of geese and duck collected in New York State confirmed results of laboratory studies with regard to PCB persistence. The laboratory results indicate that the concentration of PCB in eggs of wild birds reported by other workers, which are frequently greater than 10 µg/g, are certainly a factor in reducing the reproductive success of these species.

INFLUENCE DES PESTICIDES ORGANOPHOSPHORES SUR LE METABOLISME DES GRAISSES NEUTRES CHEZ LE RAT

BUCHET J.P., LAUWERYS R., ROELS H.

Unité de Toxicologie Industrielle et Médicale, Université Catholique de Louvain - Belgique

RESUME

Le problème toxicologique posé par l'utilisation sans cesse croissante des pesticides organophosphorés est l'effet à long terme d'une exposition continue à de faibles concentrations, par exemple sous la forme de résidus alimentaires. Outre l'inhibition des cholinestérases, l'inactivation de nombreuses hydrolases peut être imputée aux esters organophosphorés : c'est notamment le cas d'enzymes importantes impliquées dans le métabolisme des lipides.

Des études effectuées in vitro ont permis la caractérisation, au moyen d'esters organophosphorés, de diverses activités glycéridasiques dans trois tissus du rat (coeur, intestin et tissu adipeux). Dans le but de vérifier si l'inhibition de ces activités enzymatiques observée in vitro se reproduisait in vivo et, en même temps, d'en examiner les conséquences éventuelles, des animaux ont été soumis (les uns, 3 mois; d'autres, un an) à un ester organophosphoré mélangé à l'alimentation (normale ou enrichie de graisse). Après sacrifice, diverses activités enzymatiques (lipases et cholinestérases) ont été determinées; divers dosages de constituants des graisses neutres (acides gras, glycérol, cholestérol) ont en outre été effectués.

Ces travaux préliminaires permettent de mettre clairement en évidence l'interférence d'un ester organophosphoré avec le métabolisme des graisses neutres in vivo. A des doses où aucun signe clinique d'intoxication ne peut encore être observé, certaines activités lipasiques tissulaires, subissent une réduction. Cette diminution n'a toutefois pas la même importance que celle subie par les cholinestérases, enzymes dont l'activité reste le meilleur témoin d'une exposition excessive aux esters organophosphorés.

EFFECT OF ORGANO-PHOSPHOROUS PESTICIDES ON NEUTRAL FAT METABOLISM IN THE RAT

by J. P. Buchet, R. Lauwerys and H. Roels

Industrial and medical Toxicology Unit, Catholic University of Louvain (Belgium)

ABSTRACT - The toxicological problem raised by the ever-increasing use of organo-phosphorous pesticides is the long-term effect of continued exposure to weak concentrations, for example in the form of residues in food. Apart from inhibition of the cholinesterases, the inactivation of numerous hydrolases can be attributed to organo-phosphorous esters. This is especially the case with certain important enzymes involved in lipidic metabolism.

Various glyceridase activities were observed *in vitro* in three rat tissues (heart, intestine and adipose tissue), using organo-phosphorous esters. In order to see whether the inhibition of these enzyme activities which had been observed *in vitro* would be reproduced *in vivo* and, at the same time, to examine the possible consequences, an organo-phosphorous ester was administered to certain animals in some cases for three months, others for one year), mixed in with their food (normal or fat-enriched). After they had been killed, various enzyme activities (lipases and cholinesterases) were determined; various quantitative analyses of neutral fat constituents (fatty acids, glycerol, cholesterol) were also carried out.

This preliminary work showed clearly that an organo-phosphorous ester does in fact interfere with the metabolism of neutral fats in the living animal. There is a reduction in certain activities of lipase tissues even with doses which do not give rise to any clinical signs of poisoning. This reduction in activity, however, is by no means as important as that suffered by the cholinesterases, and it is the activity of these enyzmes which is the best indicator of excessive exposure to organo-phosphorous esters.

THE DISTRIBUTION AND METABOLISM OF POLYCHLOROBIPHENYLS

Maths BERLIN, John GAGE, Stina HOLM

Department of Environmental Health, Lund, Sweden

SUMMARY

Commercial mixtures of polychlorobiphenyls (PCBs) contain a large number of components which vary both in the number and orientation of the chlorine atoms. PCBs are widely distributed in the environment and are stored in fatty tissues of animals and man, but analysis has revealed that the proportions of the various PCBs in fat usually differ from those occuring in the commercial products. It is very likely that this selective accumulation is due mainly to differences in the rates at which the various PCBs undergo metabolic degradation by the components of an ecosystem.

One important factor controlling the rate of metabolism is the number of chlorine atoms in the molecule. PCBs containing less than five chlorines are not found in human fat; the lowest chlorinated compound present in significant amounts is the 2, 4, 5, 2, 5, - pentachlorocompound. The distribution and metabolism of a ^{14}C-labelled sample of this PCB has been studied in the mouse by autoradiographic and analytical techniques; it has been found to be fairly rapidly excreted in faeces, mainly as a phenolic metabolite, with a half-time of about seven days. A major component of the PCB in human fat is the 2, 4, 5, 2, 4, 5, - hexachloro compound, and a ^{14}C-labelled sample of this has been similarly studied in the mouse. As expected, this PCB is retained in fat for longer periods and is much more slowly excreted; after 7 days only about 6% of the dose appears in faeces.

The number of chlorine atoms is not the only factor which determines the metabolic degradation of PCBs; the position of the chlorine atoms in the molecule also has an influence. The retention in fat of a range of tetra-, penta- and hexachlorobiphenyls has been studied in the mouse, and relations between structure and tissue storage have been investigated.

The experimental results in the mouse will be related to findings in other species, including the monkey.

RELATION OF THE PHYSICAL/CHEMICAL STATE OF A PLASTICIZER, DI(2-ETHYLHEXYL)PHTHALATE (DEHP) TO ITS BIOLOGICAL DISPOSITION AND ACTION.

R.J. RUBIN, C.O. SCHULZ

Department of Environmental Medicine, Johns Hopkins School of Hygiene and
Public Health, Baltimore, Maryland, 21205, U.S.A.

ABSTRACT - The annual American production of phthalate ester plasticizers is approximately 1 billion pounds. With recent evidence of its widespread environmental distribution, considerable interest has centered on its potential toxicologic hazard (Environmental Health Perspectives 1 (3) 1973). Because DEHP, the most widely used phthalate, is a highly water-insoluble oil, we have been interested in its disposition and biological effects when administered in different physical states by various routes. Three different preparations have been studied: (1) a sonicated aqueous emulsion (DEHP 50 mg/ml) which was milky white and completely opaque, containing 19 x 10^6 droplets/ml with a diameter of 1.9 - 2.6 μ, (2) a detergent-dispersed preparation (50% DMSO, 5% Tween 80, and 45% Saline-DEHP 100 mg/ml) which was opalescent and contained 5.4 x 10^6 droplets/ml, 10.5 - 42 μ in diameter, and (3) a detergent-solubilized preparation (25% DMSO, 10% Tween 80, and 65% Saline-DEHP 50 mg/ml) which was completely transparent and had no visible droplets. Preparation (1) i.v. had a biphasic rate of disappearance from the blood with half-times of 9 and 22 minutes; the DEHP accumulated primarily unchanged in the liver. Preparation (3) disappeared at a single rate with a half-time of 21 minutes and accumulated primarily as unchanged DEHP in the muscle and bony skeleton. With either preparation, approximately 67% of the dose is recovered as water-soluble metabolites in the urine and feces after 24 hours. Following oral DEHP (in corn oil) or the intraperitoneal administration of preparations (1) or (3), systemic absorption is indicated by the appearance of water-soluble metabolites of DEHP in the urine and feces. However, the rates of absorption are slow relative to metabolism and excretion since significant accumulation of DEHP or its metabolites is not detected in the blood. In addition, only trace amounts of DEHP or its metabolites were detected in various organs with the exception that, following i.p. administration, significant amounts of unchanged DEHP were found in the eviscerated carcass (essentially muscle and bone). At a dose of 250 mg/kg i.v. preparation (1) resulted in a significant depression of in vivo reticuloendothelial (RE) function; preparation (2) had a 2-1/2 fold greater effect; while preparation (3) produced no significant alteration. These results clearly implicate the particle size and number in the RE effect and indicate no direct inhibitory effect of the DEHP molecule. DEHP, 125 mg/kg i.v., resulted in a significant prolongation of hexobarbital sleeping time, preparation (1), which has a greater accumulation in the liver, producing a greater effect than preparation (3). Marked pulmonary edema was noted following the i.v. administration of preparation (3) at 200 mg/kg; 300 mg/kg killed 50% of the rats by asphyxiation. The same effect was seen with DEHP solubilized in 15% Tween 80 only. Edema was not seen in vehicle-injected controls, indicating an interaction between DEHP and Tween 80. These results emphasize the need for knowledge of the physical state of DEHP in evaluating its toxicologic potential.

./.

This work was supported by grants 00034, 00454, and 44887 from the National Institute of Environmental Health Sciences, Contract NAS-5-22071 from NASA, and subcontract 72-29903 from the National Heart and Lung Institute.

THE EFFECT OF MERCAPTODEXTRAN AND N-ACETYLHOMOCYSTEINE ON THE EXCRETION OF MERCURY IN MICE EXPOSED TO METHYL MERCURIC CHLORIDE

JAN AASETH, TOR NORSETH

University of Oslo, Rikshospitalet, Oslo, Norway.

ABSTRACT - In order to prevent the reabsorption of biliary excreted mercury in methyl mercuric chloride exposed mice, the animals were treated with a macromolecular polythiol (Mercaptodextran) synthesized by thiolating a dextran compound using N-acetylhomocysteine thiolactone.

The polythiol given in food at a concentration of 5% reduced the average biological half time of mercury from 11.6 days to 5.9 days. Mercury levels in blood, liver and kidney were reduced to about 50% after 10 days compared to control animals, the brain level was reduced to about 70%. Feacal excretion of mercury compounds was not changed during 10 days, but urinary excretion increased by a factor of 5.

The effect of the macromolecule seems to be related to N-acetylhomocysteine being released in the gastrointestinal tract, as this compound given alone had the same effect as the macromolecule. Corresponding results could not be obtained by intravenous injection of N-acethylhomocysteine thiolactone. This indicates the mechanism to include forming in the gastrointestinal tract of a N-acetylhomocysteine-mercury complex which is easily reabsorbed and excreted in the urine.

POLLUTION DES ALIMENTS PAR LES HYDROCARBURES PARAFFINIQUES: ETUDE DU DEVENIR DE CES SUBSTANCES CHEZ LES ANIMAUX SUPERIEURS .

JACQUES TULLIEZ

INRA - CNRZ, Laboratoire de Recherches sur les Additifs Alimentaires.
78350 Jouy-en-Josas, France

RESUME.

L'étude du métabolisme des hydrocarbures aliphatiques chez les mammifères présente un intérêt certain, à la lecture de plusieurs travaux récents, faisant état de l'augmentation très nette depuis 1940 des cas de lipidose folliculaire de la rate et de l'accumulation d'hydrocarbures dans les nodules lymphatiques chez l'Homme. Des hydrocarbures aliphatiques ont également été isolés du tissu artériel et des plaques athéromateuses chez l'Homme. Des lésions, scléroses et dégénérescences ont été provoquées chez le Rat et le Lapin après ingestion prolongée de doses importantes d'huiles minérales. Les hydrocarbures isolés des tissus humains ont pu être identifiés comme provenant de l'ingestion d'huiles minérales qui seulent renferment des cycloparaffines, en revanche, les n-alcanes peuvent provenir également des aliments, les végétaux renfermant à l'état naturel de 0,001 à 0,1% de n-alcanes lourds (C_{17} à C_{31}).

En dehors de tout usage thérapeutique ou diététique, la quantité annuelle d'hydrocarbures ingérés par individu a été évaluée à 400 g aux Etats-Unis. La FDA a évalué à 50 g/an/individu la quantité d'huiles minérales ingérées. L'origine de ces dernières se situe au niveau des traitements technologiques alimentaires (enrobage des fruits, revêtement intérieur des emballages alimentaires en carton, agent de démoulage ....).

Le développement récent de la production de levures d'alcanes destinées à l'alimentation animale et plus tard sans doute à l'alimentation humaine pose un problème analogue. Ces levures, lorsqu'elles sont cultivées sur gas-oil, contiennent des résidus d'hydrocarbures (cyclo- et iso-paraffines) dont le taux maximum autorisé est de 0,08%. Des sources nouvelles de protéines, telles les algues spirulines, contiennent des quantités non négligeables d'hydrocarbures (0,15% d'heptadécane).

Les travaux suivants sont présentés:

- Une étude comparative de l'absorption des différentes paraffines et des quantités résiduelles non métabolisées, fixées dans la carcasse de l'animal.

Les iso-paraffines semblent avoir un comportement particulier; bien que très largement absorbées, elles ne donnent pratiquement pas de résidus.

Cyclo et n-paraffines ont un comportement voisin; seul le nombre d'atomes de carbone semble intervenir. Les différents hydrocarbures étudiés ont permis la mise en évidence d'une sorte de discontinuité au niveau C_{20} - C_{21}, au delà de laquelle les quantités résiduelles deviennent très faibles voire nulles.

./.

- Une expérience destinée à suivre l'accumulation de l'heptadécane dans les carcasses et les différents tissus de rats recevant un régime où les spirulines constituent la source unique de protéines.

- Une étude plus fine du stockage réalisée, également sur des rats, à la suite de l'ingestion d'un régime alimentaire renfermant une dose élevée de dodecylcyclohexane. Un niveau de saturation des tissus en ce produit ayant été atteint, l'évolution de la quantité stockée a été étudiée chez des rats soumis à un régime amaigrissant.

PARAFFIN HYDROCARBON POLLUTION OF FOOD : RESEARCH ON THE DEVELOPMENT OF THESE SUBSTANCES IN HIGHER ANIMALS.

INRA - CNRZ, Food Additives Research Laboratory
78350 **Jouy-en-Josas, France**

ABSTRACT - Several recent studies noting the very distinct rise since 1940 in the incidence in humans of follicular lipidosis of the spleen and hydrocarbon accumulation in the lymph nodules are of considerable interest in the study of the metabolism of aliphatic hydrocarbons in mammals. Aliphatic hydrocarbons have also been isolated in human arterial tissue and atheromatous plaques. Prolonged ingestion by rats and rabbits of considerable quantities of mineral oils produced lesions, scleroses and degenerative effects. It has been possible to identify the source of hydrocarbons isolated in human tissues as the ingestion of mineral oils, which are the only source of cycloparaffins. On the other hand, n-alkanes can also come from food, since plants contain in their natural state between 0.001% and 0.1% (C_{17} to C_{31}) of heavy n-alkanes.

The annual hydrocarbon intake per person, apart from that taken for therapeutic or dietetic purposes, has been estimated in the United States as 400g. The FDA has estimated the intake of mineral oils per person per year as 50g, the source of which is to be found in technological food processing (wrapping of fruit, inner lining of cardboard food containers, non-stick coatings etc.)

A similar problem is created by the recent development of alkane yeast production for animal feeding and later, doubtless, for human food. When these yeasts are cultured on fuel oil, they contain hydrocarbon residues (cyclo- and iso-paraffins), the maximum permissible proportion of which is 0.08%. New sources of proteins, such as spiruline algae, contain not inconsiderable amounts of hydrocarbons (0.15% heptadecane).

./.

The following studies are presented :

- A comparative study of the absorption of different paraffins and non-metabolised residues in the animal carcass.

The behaviour of iso-paraffins seems to be special; although they are very largely absorbed, they leave almost no residues.

The behaviour of cyclo- and n-paraffins is closely related; only the number of carbon atoms seems to make a difference. As a result of the studies of different hydrocarbons, it has been possible to show a kind of discontinuity at the level of C_{20} - C_{21}, beyond which residual amounts become very slight, or even nil.

- An experiment to trace the accumulation of heptadecane in the carcasses and different tissues of rats given a diet in which spirulines constitute the sole source of proteins.

- A closer study of the storage in rats given a diet with a large dodecylcyclohexane content. When the saturation of the tissues with this substance reached a certain level, the development of the quantity stored was studied in rats subjected to a reducing diet.

DISTRIBUZIONE NELL'ORGANISMO DELLO IONE FLUORO INTRODOTTO PER VIA DIGERENTE AD ALTE DOSI E SUO PASSAGGIO TRANSPLACENTARE

G. SCASSELLATI SFORZOLINO, A. SAVINO

Istituto d'Igiene dell'Università degli Studi di Perugia, Italia

---

RIASSUNTO - Sono state alimentate coniglie con dieta controllata contenente un elevato tenore di F^- (60 ppm); dopo 9 settimane le coniglie sono state sottoposte ad accoppiamento e dopo la nascita dei piccoli sono state sacrificate insieme ai neonati. Durante il periodo dell'esperimento, durato 100 giorni, sono stati controllati i seguenti parametri:

a) escrezione urinaria giornaliera dell'F^-;
b) eliminazione giornaliera dell'F^- con le feci;
c) calcolo della quota di F^- assorbita su quella introdotta;
d) dosaggio dell'F^- nelle ossa, nei denti, nella muscolatura e nei principali organi molli delle coniglie al termine dell'esperimento;
e) dosaggio dell'F^- nei neonati e nelle placente.

I dati ottenuti sono stati confrontati con i risultati osservati in eguali indagini condotte su coniglie non gravide.

FLUORINE ION DISTRIBUTION IN THE ORGANISM FOLLOWING INGESTION OF HIGH DOSES OF FLUORINE AND ITS PASSAGE THROUGH THE PLACENTA

G. SCASSELLATI SFORZOLINO , A. SAVINO

Institute of Hygiene, University of Perugia - Italy

ABSTRACT- Rabbits were fed on a controlled diet containing a high F^- content (60 ppm); 9 weeks later the rabbits were allowed to mate and after the offspring were born all the animals including the offspring were destroyed. The following measurements were carried out during the test period of 100 days: a

a) daily excretion of F^- in urine;
b) daily excretion of F^- in faeces;
c) calculation of the amount of F^- absorbed as compared to that administered;
d) quantity of F^- in the rabbits' bones, teeth, muscles and principal soft organs at the end of the experiment;
e) quantity of F^- in the offspring and in the placentas.

The data obtained were compared with the results of similar experiments carried out on non-pregnant rabbits.

INCREASED RISK OF ACUTE AND CHRONIC RESPIRATORY DISORDERS FOLLOWING LONG TERM AIR POLLUTION EXPOSURES

R. CHAPMAN, J. FRENCH, J. FINKLEA, C. HAYES, G. LOVE

EPA, Research Triangle Park, NC., U.S.A.

ABSTRACT - In 1970 and 1971, the U.S. Environmental Protection Agency conducted several epidemiologic surveys that related long-term air pollution exposures to health effects. One such effect, studied in about 5500 children and adults in Chicago and New York, was the incidence of acute respiratory disease (ARD). Another such effect, studied in about 19.000 young adults in New York, Utah, and Idaho-Montana, and in about 42.000 military inductees in Chicago, was the prevalence of chronic respiratory disease (CRD).

The findings of the Chicago and New York ARD studies suggested that reduced rates of ARD would result from improvements in existing air quality. In Chicago, it was estimated that reduction of annual average sulfur dioxide (SO_2) levels from about 110 $\mu g/m^3$ to about 57 $\mu g/m^3$, and of suspended sulfate (SS) levels from about 18 $\mu g/m^3$ to about 15 $\mu g/m^3$, would promote reductions in total ARD incidence. Such reductions in ARD could be expected even in the face of continued exposure to total suspended particulate levels of about 110 to 150 $\mu g/m^3$. In New York, exposure for one to three years to annual average SO_2 levels of about 250 $\mu g/m^3$, accompanied by SS levels of about 22 $\mu g/m^3$ and TSP levels of about 94-117 $\mu g/m^3$, was associated with a significant increase in the incidence of acute lower respiratory illness.

In both areas, restricted activity and physician visits occured with excess frequency in neighborhoods of high pollution exposure. Illness frequency varied directly with parental cigarette smoking and socioeconomic status. The effect of air pollution on ARD was most marked in residentially stable families.

In all four CRD studies, chronic bronchitis prevalence was significantly elevated in neighborhoods of elevated pollution exposure. The effect of pollution on CRD prevalence generally ranged from about one-tenth to about one-third of the effect of cigarette smoking. Among fathers in New York, the pollution effect on CRD was observed to be stronger than the smoking effect. Though the latter finding is very tentative, it suggests that air pollution exerts a stronger effect on CRD prevalence than had been anticipated. In general, the effect of pollution relative to smoking was strongest in the urban areas of high TSP exposure, Chicago and New York.

In all four areas, the effects of pollution and cigarette smoking were found to be roughly additive. That is, the sum of the excess prevalence rates attributable to pollution and smoking separately was similar to the excess prevalence rate among smokers in the more polluted communities.

BRONCHITE CHRONIQUE, SYMPTOMES RESPIRATOIRES ET POLLUTION ATMOSPHERIQUE

P. REY, D. RAMACIOTTI, B. VOINIER, R. LANG

Institut de médecine sociale et préventive, Université de Genève,
Genève, Switzerland.

RESUME - Dans une enquête portant sur 2550 personnes appartenant à la population active de Genève, nous avons récolté les renseignements suivants:

a) Anamnèse respiratoire telle qu'elle est fournie par le questionnaire sur la bronchite chronique du British Medical Council traduit en français par la CECA.

b) Performance respiratoire: débit expiratoire de pointe, FEV_1 et FEV_3.

c) Anamnèse socio-professionnelle comprenant l'exposition aux polluants industriels et aux intempéries.

d) Informations générales (sexe, âge, état-civil, origine, etc.)

Les relations entre la pollution atmosphérique et les phénomènes respiratoires ont été étudiées de trois manières différentes:

a) Comparaison de prévalence des symptômes respiratoires entre des secteurs présentant des niveaux croissants de pollution par les cheminées.

b) Etude de quelques facteurs intrinsèques et extrinsèques agissant sur la performance respiratoire au moment de l'examen.

c) Mise au point d'un profil du bronchitique et du non-bronchitique porteur de manifestations respiratoires à l'aide de plusieurs analyses multivariées rangeant, par ordre d'importance, les facteurs intrinsèques et extrinsèques considérés.

L'application de ces méthodes a permis d'une part de valider le questionnaire du British Medical Council pour la bronchite chronique et d'autre part de développer ce concept que seule une approche multivariée donne l'occasion d'attribuer à l'exposition aux polluants atmosphériques sa juste place par rapport à d'autres facteurs d'influence.

CHRONIC BRONCHITIS - RESPIRATORY SYMPTOMS AND ATMOSPHERIC POLLUTION

P. REY, D. RAMACIOTTI, B. VOINIER, R. LANG

Université de Genève, Institute of Social and Preventive Medicine
Switzeland

SUMMARY - A survey of 2,550 people belonging to the working population of Geneva collected the following information:

a) Respiratory anamnesis, as provided by the chronic bronchitis questionnaire produced by the British Medical Council and translated into French by the ECSC.

b) Respiratory performance: forced expiratory volume, FEV_1 and FEV_3.

c) Social and professional anamnesis, including exposure to industrial pollutants and adverse atmospheric conditions.

d) General information (sex, age, civil status, origin, etc.).

The relationship between atmospheric pollution and respiratory phenomena was studied from three different angles:

a) A comparison of the prevalence of respiratory symptoms in sectors with increasing levels of pollution from chimneys.

b) A study of certain intrinsic and extrinsic factors affecting respiratory performance at the time of the examination.

c) The preparation of a profile of the bronchitic and non-bronchitic patient showing certain respiratory symptoms, using several multivariate analyses, based on the intrinsic and extrinsic factors in order of importance.

By applying these methods, it was possible both to test and approve the British Medical Council's questionnaire on chronic bronchitis and to develop the idea that only a multivariate approach can correctly determine the importance of exposure to atmospheric pollutants compared with other factors.

86

EPIDEMIOLOGICAL STUDIES OF LUNG DISEASE IN URBAN AND RURAL COMMUNITIES

AREND BOUHUYS, CHARLES A. MITCHELL, ROLAND HOSEIN, JANET SCHOENBERG,
RALPH BINDER, RICHARD S.F. SCHILLING

Yale University Lung Research Center, New Haven, Conn., U.S.A.

ABSTRACT - Previous epidemiological studies on the prevalence of chronic bronchitis and other lung diseases in communities have generally used population samples. Due to the small numbers of persons in defined subgroups of such population samples (e.g., nonsmoking male lifetime rural residents without known occupational inhalant exposures, age 35-44 years), such studies can only deal with a limited number of variables which may affect the prevalence of lung diseases. In particular, the small numbers of nonsmokers in such population groups limits one's ability to detect influences of variables other than smoking, such as community air pollution. Computerized methods now enable us to broaden the scope of such surveys to total community populations, to a wider range of questions concerning lung disease, and to more sophisticated lung function tests. For this purpose, we have developed a mobile computerized laboratory, in which standardized interviews on respiratory symptoms and environmental exposures as well as pulmonary function testing are conducted simultaneously on two terminals connected to a PDP8 computer using a time-sharing system. With this facility, we have recorded respiratory symptoms, lung function and data on environmental exposures of about 2500 residents of a rural town (Lebanon) and 1500 residents of an urban community (Ansonia), both in Connecticut, U.S.A. In March through June 1974, we will study approximately 4000 residents of a rural area (Winnsboro) in South Carolina, U.S.A. A total population census as well as door-to-door surveys in selected areas of the communities enable us to establish the validity of our findings in terms of the total population. 24-hour environmental measurements, including suspended particulates, sulfur dioxide* and total oxidants, have been obtained at least weekly at several sites in both Connecticut towns. These observations were begun at the time of the surveys and were continued in order to obtain year-round data on atmospheric pollution in both communities. We have recently begun making measurements in South-Carolina. In addition to area sampling, we are using personal samplers to assess the 24-hour pollutant load in selected subjects in the urban community; these data have already shown that indoor pollution probably adds considerably to the total particulate pollutant load. *nitrogen dioxide

These surveys will allow us to determine the prevalence and severity of several forms of obstructive lung diseases in different living, working and geographical environments. By studying large numbers of people in detail, the contribution of genetic as well as environmental factors to the etiology of obstructive lung diseases will be assessed. Nonsmokers not exposed to occupational air pollutants are particularly important when comparing residents of urban, polluted areas with those of rural, relatively unpolluted areas, in order to define any deleterious effects of community air pollution. Data analysis until now has shown an unexpectedly high prevalence of chronic cough and other respiratory symptoms among older, lifetime rural residents (males and females).
A comparison of selected subgroups of males and females in the urban and rural communities (Ansonia and Lebanon, Ct.) will be presented at the symposium.

USES OF MORTALITY AS A MEASURE OF THE HEALTH EFFECTS OF AIR POLLUTION

*SAMUEL C. MORRIS, **MAURICE A. SHAPIRO

*Graduate School of Public Health, University of Pittsburgh
Pittsburgh, PA 15261 - U.S.A.
**Westernport Bay Environmental Study, East Melbourne, Australia.

ABSTRACT - The data obtained in a thirteen year follow-up of mortality in Seward and New Florence, Pennsylvania, USA, were used to compare the results obtained from the use of several methodological techniques in the study of mortality differences. Seward, the site of a coal fired electric power plant, has been subjected to air pollution levels several times that of New Florence. Measures of air pollution levels in both communities were available. Sample populations drawn from the two communities in 1960 formed the base population for the follow-up.

Comparison of age-sex adjusted mortality in the total population of the two towns showed that Seward exhibited consistently higher mortality rates than New Florence. Application of information available from the sample population, however, showed that there were greater differences in mortality within each community due to smoking than between the two communities. The higher mortality rates of smokers makes comparisons between populations with similar heavy smoking habits a more powerful test of mortality differences due to air pollution than comparisons of populations with mixed smoking habits.

Increased length of residence in Seward was associated with increased age-adjusted mortality. In the control community, the reverse was true. Comparisons of long term residents is a better test of mortality differences due to air pollution exposure than total population comparisons. The process of self-selection of in-migrants appears to be associated with air pollution levels in the community. The attraction of better medical care facilities was not a factor in this instance.

Two approaches to the analysis of mortality differences were utilized in parallel. One calculated expected deaths based on the person-years of risk over the study period, the other *a priori* expected mortality in the population based on standard population life tables. The different interpretations of results and the methodological advantages of each are explored.

The findings demonstrate that small differences in the prevalence of smoking or in length of exposure could seriously affect the validity of studies not taking these factors into account. The nature of the resulting error is examined. The role of mortality studies in evaluation of the effects of air pollution on human populations is examined in terms of the kinds and value of information that can be gained, and the cost, effort, and time required for the conduct of the studies. The requirements, opportunities for, and specific uses of alternative research designs are presented.

EFFECT OF INDUSTRIAL AND URBAN AIR POLLUTION ON HUMAN ORGANISM

WANDA DOBRYSZYCKA, STANISŁAW IWANKIEWICZ, KAZIMIERZ JACYSZYN,
SABINA KOTLAREK-HAUS, EDWARD OLEKSYK, K.STANKOWSKA

Department of Clinical Investigation and Department of Toxicological
Chemistry of the Bio-Pharmaceutical Institute, Institute of Neurology
and Sense Organs, Hematologic Clinic of the Institute of Internal
Diseases, Medical School of Wrocław - Poland.

ABSTRACT - Four population groups living in different zones were examined: group I composed of urban subjects exercising professions exposed to pollution due to heavy traffic and smokes, groups II and III made up of inhabitants of the villages in the vicinity of copper founderies, exposed to industrial smoke containing Pb, Cu, Zn, SO_2 etc; control group IV consisted of rural population living in area where industrialization was nil and where any possible pollution due to road traffic was minimal.

All the persons were subjected to general medical, otolaryngological, chest X-ray, audiometric, electrocardiographic, spirometric, blood pressure, hematologic examinations. Moreover, the following biochemical blood components were determined: total protein of serum, electrophoretical distribution of serum protein fractions, seromucoid level and its content in total protein of serum, concentration of sialic acid, haptoglobin, caeruloplasmin, alpha$_1$-trypsin inhibitor; activities of pseudocholinesterase, alanyl- and aspartyl- aminotransferases, alkaline and acid phosphatases, gamma-glutamyltranspeptidase in serum, as well as lactate dehydrogenase with electrophoretic distribution of isoenzymes, aldolase, glucose-6-phospho-dehydrogenase, acetylcholinesterase, delta-aminolevulinic acid dehydratase, aspartyl aminotransferase in erythrocytes, and Pb and Cu content were measured.

Biochemical studies of blood have showed numerous differences among particular groups in Pb and Cu content, in levels of acute phase reactants as well as in many enzymatic activities. Harmful effect of Pb, Cu and other compounds present in industrial smokes on populations living in the vicinity of founderies, has been shown.

EPIDEMIOLOGIC STUDIES OF DDT AND DIELDRIN RESIDUES AND THEIR RELATIONSHIP TO HUMAN CARCINOGENESIS.*

JOHN E. DAVIES, ANA BARQUET, C. MORGADE, AMERICO RAFFONELLI

University of Miami, Miami, Florida, U.S.A.

ABSTRACT - In contrast to dieldrin residues serologic and adipose surveys of the human DDT residue in the population of South Florida exhibited significant demographic characteristics in both tissues. Total DDT residues were higher in blacks than whites, were age and social class dependent; higher residues being found in the less affluent in both races. Similarly, geographic distribution differences have been identified. These demographic and geographic distribution frequencies emphasize the significant contribution of non-dietary sources of DDT in incidental DDT pollution and the identification of clustering within homes and environmental studies in Bahamian island population implicated household dust as a major contributant to this type of pollution in tropical areas. When adipose surveys were stratified for these differences no significant differences in Total DDT adipose residue were observed in autopsy and biopsy comparisons from 122 cancer cases when compared with race, sex and social economically matched controls. Similarly, in separate comparisons of these residues in 24 lung cancers, 14 gastrointestinal cancers, 29 breast cancers and 15 generalized metastatic carcinomas, no significant differences were observed. The complexities of case control residue studies are described.

---

*This study was supported in part by the Division of Pesticides, Community Studies, Office of Pesticides, Environmental Protection Agency, through the Florida State, Division of Health, under contract number 68-03-0088. The views expressed herein are those of the investigators and do not necessarily reflect the official viewpoint of the Environmental Protection Agency.

EPIDEMIOLOGY OF INTOXICATION IN INDUSTRY

M.A. EL BATAWI

Occupational Health, World Health Organisation, Geneve, Switzerland

ABSTRACT - The value of carrying out longitudinal studies of environmental exposure to different concentration levels of toxic substances in industry and the corresponding biological effects on man is undeniable in establishing criteria that are based on human experience. A survey has been conducted in several countries to find out the extent to which different institutions have carried out such studies. The results show that, although there is a good deal of valuable information obtained from epidemiological studies (a review of which will be presented) of exposure to certain toxic agents such as carbon disulphide, organic solvents, lead and other heavy metals, there is an outstanding need for the development of epidemiological methods in industry and for international collaboration in this field.

NONLINEAR MODELS IN MULTIVARIATE ANALYSIS APPLIED IN EXPOSURE ASSESSMENT

V. ŠTĚPÁNEK

Czechoslovak Research and Development Centre for Environmental
Pollution Control UNO/WHO Programme, Prague, Czechoslovakia

ABSTRACT - In the analysis of data on human exposure to environmental pollutants there is an outstanding need for mathematical and statistical techniques that are capable of obtaining empirical solutions to highly non-linear relationship between a large number of variables. There exist techniques seeking a solution between a set of input variables (e.g. age, sex, social conditions, etc.) and a categorized dependent variable (e.g. health effects). If the dependent variable is stochastic, we are frequently concerned with its expectation as a function $\gamma(x_1, x_2, \ldots, x_q)$ of a number of variables defining the conditions. We will restrict ourselves to the polynomial response surface $y = \gamma(x_1, \ldots, x_q)$ and find the estimates of the parameters in a quadratic model including all terms of second order. Furthermore an estimate of the variance is obtained and the adequacy of the model is tested.

Experimental designs from which the coefficients of the model can be estimated are discussed and their standard forms are shown, which makes the exposition clearer. A 3^2 factorial design is presented as a second order design, i.e. such a one enabling to estimate the parameters β_{ij} at the quadratic terms in the model. It is emphasized that we need not restrict ourselves to designs that are simple complete factorial and that we can use replicate results only for some values of the input variables in order to obtain an unbiased estimate of the residual variance.

Two or more designs can be compared by comparing the accuracy of estimation of $\gamma(x_1, \ldots, x_q)$ expressed by the variance of the estimator $\hat{\gamma}(x_1, \ldots, x_q)$. The comparison is sometimes simplified by the use of rotatable designs, in which the variance of the estimator depends only on the "distance" of the point $(x_1, \ldots, x_q)$ from the center of the experimental system. A brief description of some designs is outlined with regard to their applications in the impacts of air pollution.

The response model is illustrated in an example on medical examinations of tonsils in selected groups of children.

LABORATORY MODEL SYSTEMS FOR THE STUDY OF THE ACCUMULATION OF CHEMICALS IN THE AQUATIC FOOD CHAIN

H. CANTON and P. GREVE

Laboratory of Toxicology, National Institute of Public Health
Bilthoven, The Netherlands

ABSTRACT - Accumulation of persistent chemicals in the food chain is an important factor in the evaluation of potential hazards to men caused by the presence of such chemicals in the environment. In order to efficiently study this accumulation, model systems on laboratory scale must be developed which give indications on the accumulating properties of a given chemical, so that - with due precautions - an estimate can be made of the consequences if that chemical - deliberately or not - is allowed to come into the environment.

In the contribution submitted, two relatively simple model systems, one for fresh water and one for salt water, will be described. In each system a phytoplankton - a zooplankton - and a fish species is included. The performance of the systems will be illustrated by experiments with α-hexachlorocyclohexane, which compound is an important contaminant of many Dutch surface waters.

Measures of Association of Some Air Pollutants, Ionizing Radiation and Cigarette Smoking with Mortality Rates

*RICHARD C. SCHWING, **GARY C. McDONALD

*Societal Analysis Department, General Motors Corp., Warren, Michigan, USA
**Mathematics Department, General Motors Corp., Warren, Michigan, USA

ABSTRACT.
Two methods are employed to estimate the association of hydrocarbons, sulfur compounds, nitrogen compounds, ionizing radiation, and cigarette smoking with some age stratified and disease specific United States mortality rates for white males. The first method is based on a ridge regression technique and the second on a sign constrained least squares analysis. The measure of association between these environmental factors and mortality are quantified as elasticities; i.e., the indicated percentage change in the average mortality rate corresponding to a 1% change in the average level of the environmental factor. Elasticities are estimated for age specific and disease specific mortality rates, and these values are then aggregated and compared to estimates corresponding to total mortality rates. Overall, consistent results are obtained using the above methods for the indices of the sulfur compounds and cigarette smoking. Many of these results differ considerably from corresponding results obtained from the ordinary least squares regression analysis; and serve to highlight the need for applying appropriate estimation methods once a reasonable mathematical model for the data has been specified. In addition to the variables already specified, these analyses do take into consideration the following groups of explanatory variables:

Climate - Precipitation, January temperature, July temperature, humidity, and solar radiation.

Socioeconomic - Age, education, sound housing, population per household, population density, % non-white, % white collar, income, and city size.

BODY BURDEN OF POLLUTANTS: COMPARTMENTAL STOCHASTIC MODELS

ALLAN H. MARCUS

Dept. of Mathematics, University of Maryland, Baltimore,
U.S.A.

ABSTRACT -

The transport of trace pollutants and radioactive tracers through the body is usually modeled as a multi-compartment linear differential system with constant exchange rates. The specific activity curves must then necessarily be mixtures of exponentials and (in certain degenerate cases) non-negative integer powers of the time since ingestion. This is observationally contradicted by many systems which exhibit exponentially modified power-law specific activity curves with either arbitrary positive powers of time (Gamma density) or negative powers of time. A physiologically plausible model (random walk with drift) is proposed by which a single four-parameter compound Poisson process for residence time of a molecule in a compartment can fit all of the observed types of specific activity curves. The parameters have a direct interpretation as constants of an age-dependent molecular exchange rate between compartments. Complex system dynamics can be modeled as a Markov renewal process. The carboxyhemoglobin levels in blood due to carbon monoxide exposure, for example, appear to require at least a two-compartment model.

This model is appropriate for evaluation of physiological response to random environmental stress since the response can be represented as a linear stochastic integral in which the specific activity function "filters" the pollutant dosage. Community air pollution can usually be modeled as a log-normal random process. Occupational and personal doses require a point process description such as a Markov renewal process, hence the physiological response is a generalization of "shot noise". Applications include: trace metal toxicology; carboxyhemoglobin levels; threshold effects; setting health standards.

ANALISI DI REGRESSIONE DEI VALORI DI PIOMBO NEL SANGUE SULL'ESPOSIZIONE ATMOSFERICA

L. FAVRETTO, L. FAVRETTO GABRIELLI

Istituto di Merceologia, Università di Trieste, Italia

RIASSUNTO - In questo lavoro è discussa una funzione modello iperbolica in alternativa a quelle già proposte per l'analisi di regressione dei valori di piombo nel sangue sull'esposizione atmosferica, nel tentativo di migliorare l'interpolazione con un modello più rispondente alla realtà fisica della relazione dose-risposta. Come esempio è considerata l'applicazione a dati della letteratura.

REGRESSION ANALYSIS OF BLOOD LEAD LEVELS ON ATMOSPHERIC EXPOSURE

L. FAVRETTO, L. FAVRETTO GABRIELLI
Istituto di Merceologia, Università di Trieste, Italy.

SUMMARY

A considerable set of data on the blood lead level in selected populations, sampled in urban areas, has been recently available, together with estimated exposures to atmospheric lead. The data have been observed to fit reasonably well to a logarithmic dose-response regression, which has been considered as one of general validity for populations having constant intake characteristics.

Other functions are here proposed for the regression analysis of these data. The functions have been found to ameliorate the statistics of the regression, and to approach more closely the physico-chemical model of the dose-response relationship.

SUR UN MODELE EPIDEMIOLOGIQUE, STOCHASTIQUE ET COMPARTIMENTAL SIMULANT L'APPARITION ET L'AGGRAVATION DE LA SURDITE

M.T.HO, E. QUINOT

INRS, Centre de Recherche, route de Neufchâteau, Vandoeuvre, France

RESUME -

Les résultats audiométriques-sonométriques dont on dispose à l'heure actuelle sont hétérogènes. Le seuil de déficit auditif à partir duquel la surdité est présumée varie en effet d'une enquête à l'autre, 25 db dans la norme I.S.O. et 35 db dans le tableau français des maladies professionnelles, par exemple. Le déficit moyen pratique lui-même donne, suivant le cas, plus ou moins d'importance à la fréquence conversationnelle 1 000 Hertz.

Il en résulte que la prévalence, c'est-à-dire la fréquence F (t,b) des surdités professionnelles apparue dans une population exposée à un niveau moyen de bruit (b) décibels, pendant la durée (t) années, diffère fondamentalement d'une enquête à l'autre. Le niveau admissible de bruit devient alors imprécis.

Le modèle stochastique compartimental proposé doit permettre d'expliquer ces disparités en s'inspirant d'une méthode épidémiologique qui a fait sa preuve dans le domaine d'une autre maladie professionnelle, la silicose.

Le paramètre fondamental de ce modèle est la probabilité d'aggravation du déficit moyen pratique d'un sujet exposé pendant un temps donné. Les déficits auditifs sont regroupés en classes et le modèle s'apparente à un processus markovien de diffusion d'un compartiment dans un autre.

La probabilité ainsi définie est une fonction du niveau moyen de bruit. Elle permet de déterminer la fréquence des surdités à craindre pour une durée d'exposition quelconque et de fixer le niveau moyen admissible de bruit. La validition du modèle ne pourra se faire complètement qu'au jour oû seront connus les résultats de l'enquête entreprise par l'I.N.R.S.dans l'industrie française; cependant, pour fixer les idées, le modèle a été confronté avec quelques données actuellement disponibles, dont il rend compte très correctement.

AN EPIDEMIOLOGICAL. STOCHASTIC AND COMPARTMENTAL MODEL SIMULATING THE OCCURRENCE AND AGGRAVATION OF DEAFNESS

M.T.HO, E. QUINOT

Institut National de Recherche et de Sécurité pour la Prévention des Accidents du Travail et des Maladies Professionnelles - Vandoeuvre - France

---

ABSTRACT - The results of audiometry and sound-level measurement presently available are heterogeneous. The hearing deficiency threshold, beyond which deafness is considered to exist varies, in fact, from one survey to another. For example, it is 25 db according to I.S.O. standards and 35 db in the French table of occupational diseases. The practical mean deficiency itself accords varying degrees of importance to the conversational frequency of 1000 Hertz.

The result is a fundamental difference in the frequency F (t,b) of occupational deafness in a section of the population exposed to a mean noise level (b) in decibels, over a given period of time (t), from one survey to another. The admissible noise level, therefore, is very flexible.

The proposed compartmental stochastic model is intended to provide an explanation of these disparities, based on an epidemiological method which proved useful in the case of another occupational disease, silicosis.

The fundamental parameter of this model is the probability of aggravating the practical mean deficiency in a subject exposed over a given period of time. Auditory deficiencies are grouped according to categories and the model has some points in common with a Markov process of diffusion from one compartment into another.

The probability thus defined is a function of the mean noise level. It makes it possible to determine the frequency of deafness which can be expected for any given period of exposure and to fix a mean admissible noise level. The model cannot be considered thoroughly tested until the results of the investigation undertaken by the I.N.R.S.* in industry in France are known. However, to obtain an indication of its efficiency the model was used with some currently available data and gave good results.

* National Safety and Research Institute for the Prevention of Industrial Accidents and Occupational Diseases.

EVALUATION DE LA CHARGE CORPORELLE EN MERCURE PAR SIMULATION NUMERIQUE

*R. MAGNAVAL, *R. BATTI, **A. BOUVILLE

*Association EURATOM-CEA, Département de Protection
BP no. 6, Fontenay-aux-Roses
**Département de Protection, Service de Protection Sanitaire,
BP no. 6, Fontenay-aux-Roses

RESUME - On évalue la quantité de méthyle de mercure et de mercure inorganique absorbée par la population après consommation de poissons.

A partir des analyses effectuées sur les poissons marins pêchés en Europe, on prend comme teneur médiane 0,5 ppm de mercure total, les trois quart de la concentration en mercure étant sous forme méthylée. On associe à cette variable, une distribution log-normale. L'évaluation tient compte aussi de la consommation de poissons. Elle est simulée de deux façons, à partir des enquêtes alimentaires effectuées antérieurement par l'Association EURATOM-CEA, d'une part, en fonction de l'âge des consommateurs, d'autre part, en prenant une distribution de la consommation par repas répartie normalement autour d'une valeur moyenne. Dans ce cas, on étudie plus particulièrement l'influence de la fréquence de consommation du poisson, elle est introduite dans le calcul sous forme de variable aléatoire simulant les cas de consommations rapprochées ou espacées. Pour calculer la charge corporelle dans ces divers cas en fonction du temps, on utilise les modèles récents proposés par les toxicologistes. On considère un seul compartiment pour l'absorption du méthyle de mercure (absorption 100%, période biologique 70 jours) et une absorption plus faible (15%) période biologique 15 jours) pour la forme inorganique.

Les niveaux de contamination et leurs amplitudes de variation sont discutés, dans un certain nombre de cas traités par simulation numérique sur calculateur, les charges corporelles en mercure diffèrent par un facteur de sécurité inférieur à dix en regard des niveaux toxiques répertoriés au Japon.

ASSESSMENT OF MERCURY BODY BURDEN BY DIGITAL SIMULATION

*R. MAGNAVAL, *R. BATTI, **A. BOUVILLE

*EURATOM-CEA Association, Département de Protection,
BP no. 6, Fontenay-aux-Roses, France.
**Département de Protection, Service de Protection Sanitaire,
BP no. 6, Fontenay-aux-Roses, France.

ABSTRACT - An assessment is made of the amount of methyl mercury and inorganic mercury the population absorbs by eating fish.

Using analyses carried out on European salt-water fish as a basis, the median content is taken to be 0.5 ppm total mercury, three-quarters of the mercury concentration being in the methyl form. Lognormal distribution is applied to this variable. The assessment also takes account of fish consumption which is simulated in two ways, using previous EURATOM-CEA Association surveys of food consumption: firstly in terms of the age of the consumer and secondly using consumption distribution by meal based on an average value. In this case the effect of the frequency of fish consumption which is introduced with the calculation in the form of a random variable simulating consumption at frequent or infrequent intervals. In order to calculate the time-dependent body burden in the various cases, recent models suggested by the toxicologists are used. A single compartment is considered - absorption 100%, biological half-life period 70 days, for methyl mercury absorption, and a lower level of absorption (15%, biological half-life period 15 days) for the inorganic form.

Contamination levels and their range of variation are discussed and in certain cases processed by digital simulation by computer; the mercury body burdens differ from the toxic levels recorded in Japan by a safety factor of less than ten.

CADMIUM-ZINC INTERACTIONS

MAGNUS PISCATOR

Department of Environmental Hygiene, The Karolinska Institute,
Stockholm, Sweden

ABSTRACT - Cadmium and zinc have many common physico-chemical properties and occur together in nature. There are, however, large biological differences. Zinc is an essential metal with short biological half-time and occurs in high concentrations in all body compartments. Cadmium is non-essential, has an extremely long biological half-time and accumulates selectively in liver and kidney, the latter organ containing about one third of the total body burden. The kidney is the critical organ and it has been estimated that at a cadmium concentration of about 200 µg/g wet weight in renal cortex renal tubular dysfunction may occur.

Exposure to cadmium will cause increased zinc concentrations in liver and kidney. This has been found in experimental animals, as well as in human beings, and animals with "normal" exposure to cadmium via food. The increase in renal zinc will be dependent on the renal cadmium concentrations and is equimolar, i.e. for every atom of cadmium deposited in the kidney a zinc atom will also be deposited. There is a limit for the equimolar increase and when the cadmium concentration has reached a certain level there is no further increase in zinc levels. Further increases of cadmium may replace zinc in some zinc-dependant enzymes necessary for reabsorptive and catabolic processes in the kidney. The cadmium concentrations in other organs are low under "normal" exposure and when there is an adequate supply of zinc there will probably be very little interference with zinc enzymes. If the intake of zinc is deficient or marginal, there is a risk for depletion of zinc in some organs, such as testis, if zinc is stored in increased amounts in liver and kidney. There is also an obvious risk for zinc depletion in the fetus of cadmium-exposed mothers.

Food habits are of importance. Thus, animal meat is generally high in zinc and very low in cadmium, ensuring a favorable ratio. Substituting animal protein sources with vegetable protein, e.g. from soybean, may give less favorable ratios, lower zinc and higher cadmium. If zinc supplements will be needed in the future, it must be ensured that the cadmium content of the added zinc compounds is very low.

HEPATIC DAMAGE AND ORGANOCHLORINE RESIDUE CONCENTRATIONS IN BODY TISSUES.

*P.C. OLOFFS, **D.F. HARDWICK

* Dpt. of Biological Sciences, Simon Fraser University, Burnaby, B.C.
Canada
** Dpt. of Pathology, Faculty of Medicine, Univ. of British Columbia,
Vancouver, B.C. Canada.

ABSTRACT - Liver specimens, taken from patients with hepatic cirrhosis, contained significantly higher concentrations of DDT, but significantly lower concentrations of heptachlor epoxide, than specimens from controls. Concentrations of dieldrin were not significantly different. No significant differences were found between cirrhotics and controls in the concentrations of any residues in brain and adipose tissues. None of the specimens contained detectable amounts of aldrin, heptachlor, lindane, or the a or y isomers of chlordane.

There was a highly significant association between lipid contents and residue concentrations in livers. Cirrhotic livers with severe fatty infiltration, determined by histopathological examination, and confirmed analytically, contained significantly higher amounts of DDT and heptachlor epoxide than did those with minimal or no fatty changes. By contrast, livers with marked fibrosis or bile stasis, contained significantly lower concentrations of DDT than those with minimal or no such changes.

In animals with experimentally induced hepatic damage, residue concentrations were significantly higher than in control animals after 3 months, but not after 9 months. Residue levels were always higher in females than in males; however, the effects of liver damage were greater in males than in females. Microsomal protein P_{450}, and mixed-function oxidase activity levels were significantly reduced immediately after pathogenesis but had resumed normal levels after chlordane administration for 9 months. However, if chlordane was not administered during this period, the enzyme activities remained much depressed.

INFLUENCE DE CERTAINES DROGUES SUR L'EFFET TOXIQUE DECLENCHE PAR L'AFLATOXINE B_1 DANS LE FOIE

YVONNE MOULE

Institut de Recherches Scientifiques sur le Cancer
Centre National de la Recherche Scientifique
94800-Villejuif - France

RESUME - L'aflatoxine B_1, mycotoxine secrétée par Aspergillus Flavus est certainement le plus puissant des hépatocancérogènes connus à ce jour. En outre, ce n'est pas simplement un cancérogène utilisé à titre expérimental dans les laboratoires: on sait qu'elle peut contaminer les aliments ingérés par l'homme et les animaux. En dehors de cette action qui se manifeste toujours après un temps de latence relativement long, l'aflatoxine déclenche à court terme des effets toxiques dans le foie, l'ampleur de ces effets variant suivant les espèces animales. Ainsi une seule injection d'aflatoxine, correspondant à une dose bien inférieure à la DL 50, inhibe sévèrement la synthèse des acides nucléiques (DNA et RNA) et des protéines dans le foie du rat. A côté de ces altérations biochimiques, on décèle des lésions morphologiques typiques telles que la ségrégation nucléolaire, l'agrégation des grains interchromatiniens ...

Le traitement préalable des animaux par divers composés (phénobarbital, méthylcholanthrène, DDT ...) qui sont connus pour induire dans le foie la synthèse des systèmes enzymatiques responsables de la métabolisation des drogues, hormones, cancérogènes et pesticides, modifie la réponse du tissu hépatique à l'effet toxique de l'aflatoxine B_1. Ce même traitement peut aussi modifier l'effet à long terme portant sur la cancérisation du foie. Les modulations de ces réponses varient selon le composé utilisé et l'espèce animale considérée. La signification fonctionnelle de ces faits est discutée ainsi que leurs implications au niveau du maintien de l'équilibre biologique de l'homme.

THE INFLUENCE OF CERTAIN DRUGS ON THE TOXIC EFFECT OF AFLATOXIN B_1 IN THE LIVER

Yvonne MOULE

Cancer Research Institute, National Scientific Research Centre
94800 - Villejuif - France

ABSTRACT -Aflatoxin B_1, a mycotoxin secreted by Aspergillus Flavus, is certainly the most powerful of the hepatocarcinogens known at present. Further, it is not merely a carcinogen used for laboratory experiments. We know it can contaminate foods ingested by humans and animals. In addition to this effect, which always becomes apparent after a relatively long latency period, aflatoxin has, in the short term, a toxic effect on the liver, the extent of which varies according to the animal species. Thus a single injection of aflatoxin, corresponding to a dose far below LD 50, severely inhibits the synthesis of nucleic acids (DNA and RNA) and proteins in rat liver. Besides these adverse biochemical changes, typical morphological lesions are detected, such as nucleolar segregation, aggregation of interchromatinic granules.

Previous treatment of the animal with various compounds (phenobarbital, methylcholanthrene, DDT ...) known to induce synthesis in the liver of the enzymatic systems responsible for the metabolisation of drugs, hormones, carcinogens and pesticides, modifies the response of the hepatic tissue to the toxic effect of aflatoxin B_1. This same treatment can also modify the long-term effect involving canceration of the liver. The modulations of these reactions vary according to the compound used and the animal species in question. The functional significance of these facts is discussed, as well as their implications for the maintenance of man's biological equilibrium.

BRONCHITE CHRONIQUE ET PERTURBATIONS FONCTIONNELLES RESPIRATOIRES EN RELATION AVEC L'EXPOSITION A DIVERSES NUISANCES : ETUDE DANS DIFFERENTS GROUPES SOCIO-PROFESSIONNELS

Q.T. PHAM, B. MIRE, J. MARTIN, P. SADOUL, J.H. KNELSON

INSERM, U.14 de Physio-Pathologie Respiratoire
Vandoeuvre-lès-Nancy - France.

RESUME - Une étude épidémiologique a porté sur 586 ouvriers de sexe masculin, âgés de 40 à 60 ans, de différents groupes socio-professionnels habitant la même région de l'Est de la France (ouvriers du bâtiment, ouvriers d'une usine sidérurgique, travailleurs sans exposition professionnelle particulière). Les sujets ont été interrogés à l'aide d'un questionnaire de la bronchite (questionnaire C.E.C.A.), examinés du point de vue clinique et fonctionnel. Les examens fonctionnels suivants ont été pratiqués : détermination de la capacité vitale (CV) du volume expiratoire maximum seconde (V.E.M.S.), du volume résiduel (V.R.), calcul des rapports VEMS/CV, VR/CT ; Epreuves au CO, en respiration unique et en régime stable au repos et au cours d'un effort de 40 watts. L'analyse des symptômes de bronchite ainsi que des perturbations fonctionnelles observées a été faite particulièrement en fonction des nuisances professionnelles rencontrées par les ouvriers durant leur travail. L'exposition professionnelle paraît, certes, jouer un rôle non négligeable sur les symptômes de bronchite et sur les perturbations fonctionnelles, mais le rôle des habitudes tabagiques est apparu beaucoup plus important: les nuisances entraînent quelques troubles respiratoires chez les non fumeurs, mais ces troubles sont beaucoup plus fréquents et plus importants chez les sujets exposés et gros fumeurs. Il apparaît un effet potentialisateur nuisance et fumée de tabac et ceci est particulièrement net lorsque l'on compare les groupes après standardisation de l'âge.

CHRONIC BRONCHITIS AND FUNCTIONAL RESPIRATORY DISORDERS IN RELATION TO EXPOSURE TO VARIOUS HEALTH RISKS: SURVEY OF DIFFERENT SOCIAL AND PROFESSIONAL GROUPS

Q.T. PHAM, B. MIRE, J. MARTIN, P. SADOUL, J.H.KNELSON

INSERM, U.14 de Physio-Pathologie Respiratoire, Vandoeuvre-lès-Nancy/France

---

ABSTRACT - An epidemiological survey was carried out on 586 male workers aged between 40 and 60 from different social and professional groups and living in the same region in Eastern France (building operatives, iron and steel workers, workers with no specific occupational health risks). The test subjects were given a bronchitis questionnaire (E.C.S.C. questionnaire) and underwent a clinical and functional examination. The following functional tests were carried out: measurement of the vital capacity (VC) of the maximum volume exhaled per second (MVES) and of the residual volume (RV), calculation of the MVES/VC and RV/TC ratios; tests for CO by single and continuous breathing, both at rest and under a 40 watt load. The bronchitis symptoms and the functional disorders that were noted have been analysed with particular regard to the occupational health risks encountered by the workers in their jobs. Indeed, occupational health risks do seem to have a not inconsiderable effect on bronchitis symptoms and functional disorders, but the effects of tobacco smoking habits appeared to be far greater; some respiratory troubles in the non-smokers are the result of the health risks to which they are exposed, but these troubles are much more frequent and more serious in the subjects who are exposed to health risks and are heavy smokers. Health risks seem to be potentiated by tobacco smoke, and this is shown especially clearly when the groups are compared on the basis of age.

LAERMBELASTUNG, KOHLENMONOXIDBELASTUNG UND KOMBINATIONSWIRKUNGEN.

M. HAIDER, E. GROLL-KNAPP, M. NEUBERGER, H.-G. STIDL

Institut für Umwelthygiene, Wien, Oesterreich

KURZFASSUNG - Für die Festlegung von Lärmgrenzwerten sind u.a. Untersuchungen der zeitweiligen Hörschwellenverschiebung (TTS) und der Hörerholungsvorgang von Bedeutung. In unseren Untersuchungen konnte gezeigt werden, dass die Rückbildung der Hörermüdung bei gleichzeitiger Lärmbelastung schon ab 65 dB verzögert werden kann. Zwischen 75 und 85 dB steigt diese Verzögerungswirkung stark an und schlägt bei etwa 85 db in zunehmende Hörermüdung um.

Ueber die Kohlenmonoxidwirkung auf den Menschen konnten wir eine Reihe psychophysiologischer Experimente durchführen, u.a. konnten dabei Auswirkungen auf die Informationsverarbeitung im Gehirn mit Hilfe von computeranalysierten Potentialen nachgewiesen werden. Um Aufschlüsse über mögliche Kombinationswirkungen zu erhalten, wurden 20 Versuchspersonen in einem Doppelblindversuch 4 Stunden mit 200 ppm Kohlenmonoxid belastet und während der letzten 1/4-Stunde einem Lärm von 105 dB ausgesetzt. Die Hörschwellenverschiebung und der Verlauf der Hörerholung (1 Stunde) zeigten keine statistisch signifikanten Unterschiede.

NOISE LEVELS, CARBON MONOXIDE LEVELS AND THEIR COMBINED EFFECTS

M. HAIDER, E. GROLL-KNAPP, M. NEUBERGER, H.G. STIDL

Institut für Umwelthygiene, Vienna, Austria

ABSTRACT - In determining limits for noise levels two of the important factors are investigations into temporary threshold shifts (TTS) and the hearing recovery process. In our investigations we were able to demonstrate that the regression of aural fatigue from coincident noise levels could be delayed from 65 dB upwards. This delaying effect increases sharply between 75 and 85 dB and at approximately 85 dB suddenly changes to an increase in aural fatigue.

We were able to conduct a series of psychophysiological experiments on the effect of carbon monoxide on man. One of our findings was evidence of the effects on data processing in the brain, which was obtained with the help of computer-analysed potentials. In order to obtain data on possible combined effects 20 subjects were subjected to 200 ppm carbon monoxide for 4 hours in a double blind test, and during the final quarter of an hour a noise at a level of 105 dB was added. No statistically significant differences were found between the temporary threshold shifts and hearing recovery time (1 hour).

INFLUENZA DELLA CARICA ELETTRICA SULLA DEPOSIZIONE DI AEROSOL NELL'APPARATO RESPIRATORIO UMANO

G. GIACOMELLI-MALTONI, C. MELANDRI, V. PRODI, G. TARRONI,
G. BOMPANE, M. FORMIGNANI, G. MAESTRI, T. DE ZAIACOMO

Comitato Nazionale per l'Energia Nucleare, Centro di Calcolo,
Laboratorio Fisica Sanitaria, Bologna, Italia

RIASSUNTO - Con questo lavoro s'intende studiare come la carica elettrica portata dalle particelle sospese nell'aria può influire sull'efficienza di deposizione di dette particelle lungo le vie respiratorie durante la respirazione normale e quella forzata.

Lo studio è eseguito su un gruppo di volontari adulti di ambo i sessi in respirazione a regime a volumi correnti e frequenza respiratoria controllati.

Vengono date curve individuali e medie di deposizione in funzione delle dimensioni per particelle rigorosamente neutre, statisticamente neutre e portanti un numero di cariche unipolari fino a qualche decina di cariche elementari per particella.

Il range di dimensione delle particelle è compreso fra 0,2 e 2,0 µm.

I dati così ottenuti vengono confrontati con i valori di deposizione precedentemente misurati dagli autori sullo stesso gruppo di persone in condizioni di carica non controllata, con valori dello stesso tipo trovati in letteratura e con quelli teorici dati dal Task Group on Lung Dynamics.

EFFECT OF ELECTRIC CHARGE ON AEROSOL DEPOSITS IN THE HUMAN RESPIRATORY SYSTEM

G. GIACOMELLI MALTONI, C. MELANDRI, V. PRODI, G. TARRONI,
G. BOMPANE, M. FORMIGNANI, G. MAESTRI, T. DE ZAIACOMO

**National Nuclear Energy Committee, Computer Centre,
Physical Health Laboratory, Bologna, Italy**

ABSTRACT- The aim of this work is to study how the electric charge carried by particles suspended in the atmosphere can affect the rate at which such particles are deposited in the respiratory organs during normal and forced breathing.

The study was carried out on a group of adult volunteers of both sexes, the rate of breathing and volume of air inhaled being controlled.

This led to individual and mean curves of deposits as a function of particle dimension for strictly neutral particles, statistically neutral particles, and particles bearing a number of single pole charges of up to a few dozen elementary charges per particle.

The range of particle dimensions was between 0.2 and 2.0 um.

The data obtained in this manner were compared with the deposits previously measured by the authors on the same group of volunteers when the electric charge was not controlled, as well as with values of the same type found in the literature, and with theoretical data from the Task Group on Lung Dynamics.

REVALUATION OF EPIDEMIOLOGICAL HEALTH EFFECTS FORMERLY ATTRIBUTED TO MEASURED LEVELS OF NITROGEN DIOXIDE IN VIEW OF SYNERGISTIC EFFECTS DUE TO COPOLLUTANTS

PETER O. WARNER, LAZIER STEVENS

Wayne County Department of Health, Air Pollution Control Division,
1311, East Jefferson Street, Detroit, Michigan 482o7, U.S.A.

ABSTRACT - Data have been collected to indicate the presence of several synergistically interfering air contaminants in ambient air in the immediate vicinity of Chattanooga, Tennessee, where epidemiological studies have classically related observed human respiratory effects to measured elevated levels of NO_2 alone.

Such data appear to support recent evidence showing the relationship between levels of small particle sulfate aerosol and incidence of respiratory disease.

The possible synergism between sulfate aerosol and NO_2 is discussed and compared to data from the recent U.S. Government Community Health Environmental Systems Study (CHESS), which consistently relate respiratory epidemiology to sulfate particulate in the particle size range below 3.5 microns.

Levels of aerosol sulfate recently measured in an urban industrial area are presented together with sulfate distribution as a function of particle size range.

It follows from these data that adverse health effects classically attributed to nitrogen dioxide may be accounted for either totally or in part by the presence of epidemiologically interfering compounds such as aerosol sulfate or acid mist whose specific measurements have not previously been a part of epidemiological surveys.

INTER-ACTION OF AIR POLLUTANTS

K. BUŠTUEVA

Central Institute for Advanced Medical Training, Moscow, USSR.

ABSTRACT - In evaluating the health effects of chemical and physical factors, it is of great importance to know the possible inter-actions between different pollutants. The biological effects of inter-actions, when present, may be synergistic, antagonistic or additive. Each type of inter-action calls for a different evaluation and different practical measures. As yet the understanding of such effects is not clear, probably because of differing definitions of terminology. For example, the combined effect of sulfur dioxide and particulates is interpreted as a synergistic effect; in the author's opinion, this is an aggravating effect. The type of inter-action depends on the levels of concentration observed - for example, the synergism shown at high levels of concentration is not always demonstrated for low levels of concentration. In fact there is little evidence of synergistic effects from ambient air pollutants; the more common type of inter-action is additive in effect.
Examples of each type of inter-action will be presented.

THE EFFECTS OF LOW LEVELS OF SO_2 AND OZONE IN THE SAME ATMOSPHERE ON HUMAN PULMONARY FUNCTION

*D.V. BATES, **M. HAZUCHA

*Dean's Office, Faculty of Medicine, University of British Columbia,
Vancouver, B.C., Canada
**Department of Physiology, McIntyre Building, McGill University,
Montreal 101, P.Q., Canada

ABSTRACT - 1. In an exposure chamber, normal subjects have breathed 0.37 parts per million of ozone in air, 0.75 parts per million of ozome in air, 0.37 parts per million of SO_2 in air, and 0.75 parts per million of SO_2 in air. Light bicycle exercise for 15-minute periods alternated with periods of rest. Measurements have been made of ventilatory flow rates and subdivisions of lung volume, and the closing capacity has been measured with radioactive xenon 133.

2. Using appropriate absorbers in front of analytical instruments, it has been possible to expose normal subjects to a mixture of 0.37 parts per million of ozone together with 0.37 parts per million of SO_2 at room temperature, with an average humidity of approximately 40%. The effects of this gas mixture on pulmonary function have been contrasted to the effects produced by the two gases when breathed individually at these concentrations.

3. Data will be presented which indicates that the breathing of the two gases together at low concentrations (0.37 parts per million of each) has a much greater adverse effect on maximal mid-expiratory flow rate than occurs when either of these two gases is breathed individually. Measurable changes in pulmonary function do occur after two hours of exposure to 0.37 parts per million of ozone alone, and to 0.75 parts per million of SO_2 alone. However, when ozone and SO_2 at low concentration are present together the maximal mid-expiratory flow rate reaches 80% of the control value after one hour and is only 55% of the control value after an hour and a half. By comparison, when 0.37 parts per million of ozone is present alone, statistical significance is only achieved at the end of a two-hour period, when the maximal mid-expiratory flow rate averages 83% of the control value.

4. In view of the possibility that changing patterns of air pollution will lead to an increasing number of environments in which both of these gases may be present together, it is urged that these results necessitate reconsideration of the maximal permissible levels of these pollutants if both of them are to be present together.

EFFECTS OF SULFUR DIOXIDE ON HEALTHY AND PERIPHERAL AIRWAY IMPAIRED SUBJECTS (1)

*FRANCIS W. WEIR (2), **PHILIP A. BROMBERG

*Department of Preventive Medicine,
Ohio State University, Columbus, Ohio - U.S.A.
**Department of Medicine,
Ohio State University, Columbus, Ohio - U.S.A.

ABSTRACT - This report describes an investigation of healthy subjects and subjects with early signs of chronic obstructive lung disease exposed to atmospheres containing sulfur dioxide (SO_2). Experiments were conducted in a $30M^3$ dynamic flow environmental chamber maintained at 22 ± 1°C and 50 ± 5% relative humidity. Exposures to 0, 0.3, 1.0, or 3.0 ppm SO_2 were ordered in randomized sequences for 120 hour periods (Series 1-healthy men) or 96 hour periods (Series 2-unhealthy men).

Subjects in Series 1 were male volunteers essentially free from detectable disease with height:weight ratios within 10% of the actuarial figures and acceptable psychological profiles. Subjects in Series 2 demonstrated peripheral airway obstruction, but were otherwise healthy. Series 2 volunteers were chosen from candidates with one-second vital capacity between 70% and 50% of total vital capacity, depressed maximum mid-expiratory flow rates, or those with abnormal closing volumes.

Daily pulmonary function measurements for both series included airway resistance at several lung volumes, functional residual capacity, static compliance, frequency dependence of dynamic lung compliance, total lung volume, single breath and continuous nitrogen washouts, timed vital capacity, and maximal expiratory flow volume curves. During Series 2, closing volume measurements were also conducted daily.

In Series 1, no significant dose-related changes were observed in subjective complaints, clinical evaluations, or most pulmonary function measurements. Significant, but minimal, reversible decreases were noted in compliance at high breathing frequencies at the 3 ppm exposure level, but these changes disappeared within 48 hours after cessation of exposures.

Clinical evaluations of Series 2 revealed a variety of subjective and objective findings. However, oomplaints could not be related to the concentration of SO_2. Inter- and intra-subject variability in the results from each pulmonary function test far exceeded the variance due to exposure to SO_2.

The evidence suggests that persons with minimal preexisting peripheral airway disease are probably not more susceptible to the effects of SO_2 than normal persons. However, the existance of prior disease confounded any attempt to define threshold concentrations of SO_2.

./.

These studies have demonstrated that most conventional methods for assessing pulmonary function are insufficiently sensitive to detect early changes resulting from exposure to SO^2 even in carefully selected healthy subjects, and, further, that assessment of air pollution effects in the large portion of the population with pulmonary disfunction may require development of entirely new methodology.

(1) Research supported by The American Petroleum Institute.
(2) Now employed at Biomedical Science Department, Research Laboratories, General Motors Corporation, Warren, Michigan 48090, U.S.A.

EMERGENCY POPULATION EXPOSURE: A METHODOLOGICAL APPROACH

(with a report on a human experiment with chlorine)

P.E. JOOSTING

TNO Research Institute for Environmental Hygiene, Delft,

M.M. VERBERK

Coronel Laboratory, Faculty of Medicine,
University of Amsterdam, Amsterdam, Netherlands

Abstract

A philosophy on public emergency exposures and the need for public emergency limits (PEL) is presented. PEL's can be used for the purpose of planning settlements, storages, transport, organizational measures, etc. PEL's apply to tolerable short term emergency exposures of the general population which is neither homogenous in its composition, nor in its responses upon foreign agents. The criteria, used in setting PEL's are discussed, with special attention to the more susceptible part of the population, as well as the question whether there exist objective physiological criteria that could be indicative for the population group at highest risk.

A report is given on an experiment with human volunteers that aimed at checking up a postulated tentative PEL for chlorine. Eight subjects, age 28-52, were exposed for two hours to 0.5, 1, 2, and 4 ppm. VC, FEV and FIV measurements before and after showed no significant differences. Subjective phenomena, recorded with 15 min.interval, showed individual, time and concentration dependent characteristics, as well as frequency distributions to which arbitrary tolerance criteria could be applied. The problem of extrapolating the findings to susceptible subjects and the use of a "safety" factor is discussed. The elaborated PEL value of 1.5, 1, and 1 ppm chlorine for 0.5, 1 and 2 hours respectively, complies with comparable PEL's from abroad, but is not consistent with the very small number of literature data that pertain specifically to subjective responses during short term exposures to moderate concentrations of chlorine.

L'INFLUENCE NUISIBLE DU BRUIT SUR LE SOMMEIL DES TRAVAILLEURS DE NUIT ET DES TRAVAILLEURS EN EQUIPE

P. KNAUTH, J. RUTENFRANZ

Institut für Arbeitsphysiologie an der Universität Dortmund,
46 Dortmund, Ardeystr. 67, Bundesrepublik Deutschland.

RESUME - Nous avons utilisé le travail en équipe réalisé de façon expérimentale pour démontrer la perturbation du sommeil dûe à l'influence des deux facteurs combinés : bruit et travail en équipe.

Nous basant sur des renseignements recueillis précédemment auprès de travailleurs de nuit, nous avons dérangé le sommeil des sujets au moyen de bruits d'enfants et de bruits de circulation (60 à 70 dB). L'enregistrement des EEG, EOG, EMG et ECG, ainsi que l'enregistrement des mouvements du lit pendant le sommeil permettaient de reconnaître dans quelle mesure le sommeil se trouvait perturbé par le bruit.

Le cours des phases de sommeil dépendant entre autres de l'heure du jour, on a pu constater dans les répercussions du bruit sur le sommeil également une certaine dépendance de l'heure du jour.

Dans le sommeil de jour, au bout de trois semaines de travail de nuit, on a pu remarquer une certaine habitude prise du bruit. L'estimation subjective de l'influence du bruit ne concordait pas avec les changements physiologiques enregistrés.

HARMFUL EFFECTS OF NOISE ON THE SLEEP OF NIGHT WORKERS AND SHIFT WORKERS

P. KNAUTH, J. RUTENFRANZ

Institute for Industrial Physiology, University of Dortmund
Dortmund, Fed. Rep. of Germany

ABSTRACT - Shift work was arranged on an experimental basis, to demonstrate disturbances in sleep which are due to the combined influence of two factors: noise, and the shift work itself.

Using as a basis information previously obtained from night workers, we disturbed our subjects' sleep by the noise of children and traffic (60-70 dB). EEG, EOG, EMG and ECG recordings, together with recordings of bed movements during sleep, were used to determine to what extent sleep had been disturbed by these noises.

Since sleep patterns depend, among other things, on the time of day, the effects of noise on sleep also depended, to a certain extent, on the time of day.

It was noticed that after three weeks of night work, subjects sleeping during the day became used to noise to some degree. Subjective assessments of the effects of noise did not agree with the physiological changes recorded.

ALTERATION IN URINARY D-GLUCARIC ACID EXCRETION AS AN INDICATION OF EXPOSITION TO XENOBIOTICS

W.R.F. NOTTEN, P.TH. HENDERSON

Institute of Pharmacology, University of Nijmegen, Nijmegen, Netherlands.

ABSTRACT - Many compounds foreign to the organism, particularly those which due to their high lipophilicity tend to remain for a long time in the body, are capable of stimulating a number of enzymes in the liver. On the one hand this affects the enzymes involved in the conversion of lipophilic toxic substances into more hydrophilic, non-toxic products. On the other hand the metabolism of "normal" body constituents can also be influenced. This stimulation, as a rule, becomes manifest in an enhanced excretion of metabolites by the urine. A well-known example is the stimulation of the D-glucuronic acid pathway in the liver, which leads to an enhanced excretion of L-ascorbic acid (in mammals excepting primates and guinea-pig) and D-glucaric acid.

In view of this, it can be questioned whether the measurement of an enhanced urinary D-glucaric acid =as a reflection of an altered liver metabolism= can serve as a reliable test for the effect of exposure to body-foreign compounds. Such a test might be especially important when exposure takes place chronically to known agents at subtoxic concentrations, for which specific test methods are absent or hard to perform, and in those cases where exposition occurs to a varied spectrum of unknown xenobiotics.

During the present study a large number of xenobiotic compounds (some drugs, organic solvents, pesticides and other environmental pollutants) were screened for their capacity to enhance urinary D-glucaric acid excretion in the guinea-pig and rat. The experimental results support the usefulness of the D-glucaric acid test as a general measure of exposition.

As far as the mechanism of the stimulation is concerned, it appears that the increased synthesis of D-glucaric acid is directly related to an acceleration of the conversion of UDP-glucose to UDP-glucuronic acid.

The applicability of the D-glucaric acid test for man in the field of industrial and environmental hygiene, will be discussed.

This work was supported by a grant from the Prevention Fund of the Dutch Ministry of Health and Environmental Hygiene.

THE ASSESSMENT OF ENVIRONMENTAL CARCINOGEN RISKS IN TERMS OF LIFE SHORTENING

ROY E. ALBERT, BERNARD ALTSHULER

Institute of Environmental Medicine, New York University Medical Center,
550 First Avenue, New York, N.Y. 10016 - U.S.A.

ABSTRACT - The conventional approach to the quantitative assessment of risks from low levels of carcinogen exposure involves the extrapolation of dose-response curves for tumor incidence. Regardless of the shape of the curve used for extrapolation, the risk assessment is made in terms of the excess incidence of cancer. This implies that the extra cancer cases bear the full effect of the carcinogen exposure and the rest of the population suffers no ill effects.

The purpose of this paper is to present an entirely different approach to the assessment of carcinogen risks in which the dominant effect of carcinogen exposure is life shortening and the impact falls both on those individuals who would have gotten cancer without the carcinogen exposure as well as the new cancer cases. This analysis is based on the interaction of age-specific tumor incidence rates and population survival in terms of age-specific mortality rates without the induced risk from carcinogen exposure; the analysis yields estimates for p (lifetime probability of developing cancer), Δ (average life-span lost by the entire population), $\bar{x}$ (the average age of cancer occurence) and δ(the average life-span loss of cancer cases). The approach utilizes the animal response data to assign, to the existing human cancer occurence, an equivalent dose of the same carcinogen which is under consideration in terms of risk evaluation. It has the great advantage that it keys the estimates of carcinogen risks to those which already exist in the environment and encompasses the variability in both susceptibility and carcinogenic exposure in humans.

MERCURY AND OTHER ELEMENTS IN BLOOD OF THE DUTCH POPULATION

*E. M. DEN TONKELAAR, *G. J. VAN ESCH, *B. HOFMAN, *P. L. SCHULLER
AND **J. H. L. ZWIERS

* National Institute of Public Health, Bilthoven
**Central Laboratory TNO, Delft, The Netherlands

ABSTRACT

Since a number of years problems exist about the toxicity of heavy metals and other elements occuring in the environment in higher levels than in the past. Concern about this started with the Minamata disease in Japan, caused by methylmercury in fish. Also reports from Sweden about fish caught in lakes polluted with mercury caused some alarm. To see whether the Dutch population, especially people eating much fish, were in danger of (methyl)-mercury intoxication, the mercury content of blood and hair was determined in a number of people. In this population the relation between fish-eating habits and mercury content was studied. People were asked whether they ate fish at least once a week, at least once a month, at least once a year or never and were divided into 4 groups accordingly. Questions about fish eating were asked for seafish and for freshwaterfish, because the mercury content of the latter is generally higher. From the results a clear correlation was found between fish eating habits and mercury content of the blood. This correlation was found especially when freshwater fish was considered. However, the mercury content of the blood was, even for the heaviest fish eaters, relatively low compared with the results for Swedish and Finnish fish eaters and much lower than the level at which clinical symptoms can be expected. The mercury content of hair did not correlate very well with blood, although in cases of relatively high mercury content of blood, the level in hair was also higher. But in general, for screening purposes of a population, mercury content of hair is not a valuable parameter.

In addition to this preliminary study, about 1200 blood samples were obtained from 18 year old men, called for medical examination for military service. These blood samples are randomly distributed over the country. In these samples mercury, lead, cadmium, arsenic and selenium are determined. From the first results it appears that the mercury content in blood of this population, of which no data about fish eating are known, is even lower than in the first study. The median and frequency distribution of the content of mercury and the other elements in the blood will be given. A possible relation between the elements and relation of blood level with residency and/or region has to be studied.

DIE ZELLKULTUR ALS TESTSYSTEM IN DER ANGEWANDTEN UMWELTHYGIENE

E. G. BECK, N. MANOJLOVIC UND ANNA B. FISCHER

Hygiene-Institut, Oekologisches Zentrum, Justus Liebig-Universität, Giessen
Med. Institut für Lufthygiene und Silikoseforschung Düsseldorf, BRD

KURZFASSUNG

Ergebnisse der Epidemiologie im Rahmen der Umwelthygiene sind die Grundlage für gezielte experimentelle Untersuchungen zur Identifizierung der relevanten Wirkfaktoren. Zur Prüfung der biologischen Wirkung dieser Stoffe, einzeln und in Kombination, kann der Mensch als Versuchsperson nur bedingt unter besonderen Sicherheitsvorkehrungen herangezogen werden. Das Versuchstier und die Zellkultur sind die entsprechenden Testsysteme.
Das Testsystem Zellkultur ist so weit ausgereift, dass es sich zur Prüfung der akuten als auch chronischen biologischen Wirkung von Fremdstoffen der Umwelt eignet. Die Schädlichkeit eines Stoffes in vitro indiziert auch seine Schädlichkeit in vivo. Das Versuchstier und die Zellkultur sind hinsichtlich Methodik und Aussagewert der Ergebnisse eng gekoppelt.

Zielsetzung der Untersuchungen ist die Anwendung der beiden Testsysteme als Screeningverfahren zur raschen Erfassung von Schadstoffen der Umwelt (Toxizität, Kanzerogenität). Das Verfahren soll zur Klärung epidemiologischer Befunde beitragen und als Entscheidungshilfe bei Präventivmassnahmen im Bereich des Umweltschutzes dienen.

Es werden Ergebnisse vorgestellt, die mit dem Testsystem Zellkultur erzielt worden sind. Geprüft wurden atmosphärischer Staub (Extrakte, Komponenten) aus Immissionen industrieller Ballungsräume sowie städtischer und ländlicher Gebiete.

THE CELL CULTURE AS TEST SYSTEM IN APPLIED ENVIRONMENTAL HYGIENE

E. G. BECK, N. MANOJLOVIC AND ANNA B. FISCHER

Hygiene-Institut, Oekologisches Zentrum, Justus Liebig-Universität,
Giessen, and Med.Institut f.Lufthygiene und Silikoseforschung,
Düsseldorf, BRD

SUMMARY - The results of epidemiological studies in the field of environmental hygiene are the basis for controlled experimental research to identify the relevant effective factors. Human beings can only be used as test persons under certain circumstances and with special safety precautions, to test the biological effect of these substances singly and in combination. The laboratory animal and the cell culture are the appropriate test systems. The cell-culture test system has been developed to such an extent that it is suitable for examining both the acute and the chronic biological effects of foreign matter from the environment. The harmfulness of a substance in vitro indicates its harmfulness in vivo as well. The laboratory animal and the cell-culture are closely connected with regard to method and validity of results.

The object of the research is the use of the two test systems as screening processes for rapid assessment of environmental pollutants (toxicity, carcinogenicity). It is intended that these processes contribute to the elucidation of epidemiological findings and serve t facilitate decisions on preventative measures in the field of environmental protection.

Results will be presented which have been obtained with the cell-culture test system. The substances tested were atmospheric dust (extracts, components) from immissions in industrial conglomerations and urban and rural areas.

EPIDEMIOLOGY OF PESTICIDE AND METAL RESIDUES

ANTHONY V. COLUCCI

Human Studies Laboratory, NERC, Research Triangle Park, N.C., USA

ABSTRACT-

Studies relating to the epidemiology of pesticide and metal residues involves the formulation of appropriate research models. These models must be formulated in order to quantitate the impact of exposures involving multiple routes to man and to test specific hypothesis relating these pollutants to adverse health effects.

Crucial to all of these studies is the investigation of human body burdens of these residues using both the general population or selected subgroups at greater risk either from occupational or geographic exposure.

The studies we have conducted have been designed to address a number of questions in several areas. The first series of investigations was aimed at determining which tissues are most suitable for monitoring body burdens of the residues in human populations. Thus blood, urine, hair, feces and placenta were analyzed for pesticide, trace metal and synthetic organic residues. In addition, multiple tissue sets were collected at autopsy and analyzed.
The second series of studies was designed to test specific hypothesis relating disease risk to pollutant levels. Typical of the questions investigated were the relationship between metals and organic burdens and cardiovascular disease and toxemia of pregnancy.

The final phase of our research efforts focused on linking tissue burdens with refined laboratory indices of health impairment. Examples of these studies include the effects of metals, organics and pesticides on placental enzyme activity, hematological indices and detoxification mechanisms along with changes in other critical clinical parameters.

This linkage of clinical and laboratory approaches to a coordinated epidemiologic system allows not only a current assessment of risk in these populations but, in addition, a more predictive posture as new pollutant problems arise.

To date these studies have yielded interesting preliminary results. Whereas easily collected specimens such as hair and blood have proven utility in estimation of environmental exposure, these tissues cannot, as yet, be considered a good quantitative indicator of many body pollutant burdens. Studies of occupationally exposed groups or groups of individuals with clinically evident disease have failed to clearly implicate pollutant burdens with either disease production or aggravation although, in general, the blood levels of these individuals do reflect increased exposure to pollutants. Studies of multiple tissue sets collected at autopsy are encouraging inasmuch as it appears these tissues will provide useful information about the pollutant burden for constructing predictive models and, in addition, provide flashback capabilities.

STORAGE MAP OF ORGANO-CHLORINE COMPOUNDS (OCC) IN HUMANS.
EPIDEMIOLOGICAL DEDUCTIONS FOR FURTHER MONITORING

*M. WASSERMANN **L. TOMATIS AND *DORA WASSERMANN

* Department of Occupational Health, Hebrew University-Hadassah Medical School, Jerusalem, Israel.

** World Health Organization-International Agency for Research on Cancer Lyon, France.

ABSTRACT -
It is characteristic of living organisms to carry the foreign compounds which enter them through continuous cycles of activity like their own components. Some of the compounds on the environment accumulate to some extent in the animal body. This storage constitutes a dynamic process.

In the framework of a joint programme WHO-International Agency for Research on Cancer and the Hebrew University-Hadassah Medical School, Department of Occupational Health, Jerusalem, the OCI storage in humans has been investigated in various populations in Africa, Asia, and South America.

Data obtained in these studies led to the conclusion that the age group 25-44 years stored the highest amount of OCI in both sexes for most populations. Since after the age of 45 years a change in the amount of OCI stored was observed, it is suggested that the age group of 25-44 years may characterize the OCI storage level of a community and can be compared with the mean storage level of stillborns in order to assess the increase in man's OCI impregnation from his fetal life.

The paper presents a map of the storage level of OCI in humans throughout the world according to data reported in literature.

Suggestions for the way of further monitoring are presented.

RELATIONSHIP OF HCB, MERCURY AND ORGANOCHLORIDE PESTICIDES IN MOTHER'S MILK, BLOOD, PLACENTA, UMBILICAL CORD AND FOETAL BLOOD

D.S. SIYALI

Health Commission of N.S.W., Lidcombe, Australia

ABSTRACT -

Samples of milk, blood, placenta, umbilical cord and cord blood from fifteen healthy women (Metropolitan area of Sydney, Australia) were collected from a leading Sydney Maternity hospital. Study of organochloride pesticide residues had shown that placenta reduced the pesticide residues level in foetal blood. Residues of DDT, HCB and Dieldrin were found but in all cases the levels of residues were lower in the foetal blood (cord blood) than in the mother's blood, with HCB being reduced more than DDT.

Ratio of mother's blood to Foetal blood was 2.9 for HCB, 1.4 for DDT.
Ratio of mother's blood to Placenta was 2.8 for HCB, 7.8 for DDT.
Ratio of Foetal blood to Placenta was 1.0 for HCB, 5.6 for DDT.

The fingicide HCB was detected in all tissues with the exception of umbilical cord. Very little literature quoting levels of HCB in human blood and tissue appears to exist. No dieldrin was found in cord blood.

Results confirm that the total residue of organochloride pesticides corresponds to the relative amounts of lipids in tissues and there appears to be dynamic equilibrium between different tissues. Blood which is readily available can be used to evaluate the level of exposure to pesticides.

Mercury was detected in low levels in placenta (0.02 p.p.m) and umbilical cord (0.04 p.p.m) but was not detected in blood.

EVALUATION OF THE HEALTH EFFECTS OF NITRATES IN WATER

Nachman Gruener and Hillel I. Shuval
Environmental Health Laboratory
Hebrew University-Hadassah Medical School
Jerusalem, Israel

SUMMARY

The standard for nitrates in drinking water was established as 45 mg/l based on limited epidemiological and experimental evidence. We initiated a broad range of toxicological and epidemiological studies to provide a scientific basis for evaluating the health effects of nitrates in drinking water. The two epidemiological studies to be reported upon here are part of this project.

One of the studies which was done among 408 healthy infants who consume appreciable amounts of tap water in powdered milk formula showed that those infants who consume water with nitrate concentrations over 45 mg/l exhibited significantly raised methemoglobin levels in their blood. The second epidemiological study was done under controlled conditions in a hospital to attempt to determine the threshold value of nitrates in water which can cause a significant increase above "normal" methemoglobin levels in infants. In this study with 115 infants we showed that nitrate levels in drinking water of about 100 mg/l can cause a significant increase in infants' methemoglobin levels.

The possible health significance of a slightly raised or subclinical methemoglobin level as found in the two studies is discussed in light of results from toxicological studies and general considerations in evaluating the risk of population exposure to chemicals in the environment.

RECHERCHES CONCERNANT L'INFLUENCE DE L'ENVIRONNEMENT POLLUE AUX RADIATIONS IONISANTES OU SUBSTANCES CHIMIQUES SUR LES NOYAUX LEUCOCYTAIRES

GH. ROSCA, STELA ROSCA AND E. T. BARSAN

Institut de Médecine et de Pharmacie, Cluj, Roumania

RESUME -

Les auteurs ont étudié, sur un grand nombre de sujets, les modifications de l'appendice nucléaire au niveau des leucocytes du sang périphérique.

D'une part, les recherches ont porté sur 500 sujets provenant de :

a) malades exposés à des radiations ionisantes (rayons X ou gamma) au cours des procédures thérapeutiques;

b) cadres médicaux et auxiliaires travaillant dans des services de radiothérapie ou la radio-diagnostique;

c) différents sujets venant pour l'examen ou le contrôle périodique médical.

Les analyses cytologiques ont mis en évidence, à un pourcentage varié, mais surtout dans le cas b.) la présence de nombreuses excrescences nucléaires sous la forme d'appendices nucléaires.

D'autre part, on a fait des investigations chez les personnes qui travaillent dans un environnement chimiquement pollué (benzène, colorants chimiques et alcools), dont on a pratiqué des examens hématologiques. Les analyses ont également mis en évidence divers aspects des mêmes modifications cytologiques.

Dans toutes les deux catégories de sujets on a comparé les données en les rapportant à celles des sujets de contrôle, tout en relevant les aspects qualitatifs et quantitatifs de diverses formes d'excrescences nucléaires. Dans le second groupe d'examens on a fait une référence aussi à l'appendice nucléaire sexuel.

RESEARCH ON THE EFFECT OF ENVIRONMENTAL POLLUTION DUE TO IONISING RADIATION OR CHEMICALS ON LEUKOCYTE NUCLEI

Ch. ROSCA, S. ROSCA, E. T. BARSAN

Genetics Laboratory of the Medical and Pharmacological Institute,
Cluj, Romania

ABSTRACT - The authors have carried out tests on a large number of persons in order to study the changes in the nuclear appendix (chromosome?) in peripheral blood leukocytes.

Research was carried out on 500 test subjects taken from the following groups:

a) patients exposed to ionising radiation (X-rays or gamma rays) as part of therapeutic treatment;

b) medical and auxiliary staff working in therapeutic and diagnostic radiology units;

c) various persons coming for examination or periodical medical checks.

The cytological analyses revealed the presence in varying degrees, particularly in the case of group b, of numerous nuclear growths in the form of nuclear appendices (chromosomes?).

In addition, blood tests were carried out on persons working in a chemically polluted environment (benzene, chemical dyes and alcohols). Various aspects of the same cytological changes were also revealed by these analyses.

For both categories of test subjects, the findings were compared with those of the control subjects, special attention being given to the qualitative and quantitative aspects of various forms of nuclear growths.

In the second group of tests reference was also made to the sexual nuclear appendix (sex chromosome?).

STANDARDISATION OF ALA-D DETERMINATION AT THE EUROPEAN LEVEL; INTERCALIBRATION AND APPLICATIONS.

*A. BERLIN, **K.H. SCHALLER, *J. SMEETS

on behalf of the participating laboratories

*Health Protection Directorate, C.E.C. Luxembourg

**Institut für Arbeits- und Sozial-Medizin und Poliklinik
für Berufskrankheiten, Erlangen, Federal Republic of Germany.

ABSTRACT - Literature data suggest that there might be important differences in the lead body burden in various European countries; differences which could be due to the diversity in dietary habits.

A recent intercomparison programme on blood lead measurements at the European scale has shown the difficulties of such determinations; at the same time the greater reliability of delta-aminolevulinic acid dehydratase (ALAD) enzymatic activity measurements in blood was demonstrated.

ALAD activities are very sensitive to variations in lead exposure at low concentrations; but their use in population surveys is hindered by the fact that only relative values are measured and that unless all the results are obtained with an identical method, the values from different laboratories are not comparable.

With the participation of twelve European institutes, we have developped, standardized and tested a method suitable for ALAD determinations corresponding to relatively high activities. The approach used will be described.

Twenty laboratories in twelve European countries have carried out the following population surveys: the ALAD activities and blood lead values were determined by each laboratory in groups of 50 males aged between 18 and 40 years, non-smokers and not having any knwon professional exposure to lead. The blood lead's were simultaneously determined by four "central" laboratories.

The results of this study will be presented and discussed with regard to the suitability of the two methods for carrying out population surveys and to the assessment of possible differences in exposure to lead in the various countries. Special studies on children, pregnant women, etc. conducted in connection with this main investigation will also be discussed.

LEAD SURVEY OF CHILDREN - ARGENTON - BOOLAROO NEWCASTLE - AUSTRALIA

A. BELL AND K.H. OUW

Health Commission of New South Wales, Australia

ABSTRACT

A survey into possible health effects due to contamination of the environment by lead emissions from the Sulphide Corporation Pty. Ltd., Cockle Creek began in 1972 and was continued by the Medical Branch of the Division of Occupational Health and Pollution Control in 1973.

Whilst these results did not indicate that the children in the Argenton-Boolaroo area were at any risk from abnormal lead absorption, the 1972 survey was not considered by the Division to be adequate, as findings were based predominantly upon lead-in-urine results (257) and only to a lesser extent upon lead-in-blood results (41).

At the International Symposium on Lead in Amsterdam in 1972 the matter of environmental lead pollution was discussed, and it was decided to adopt the recommendations set down by R. Zielhuis in his paper "Lead Absorption and Public Health, an Appraisal of Hazards" (as amended), that is, that 50% of the children tested should have a lead level of 20 µg or less per 100ml. of blood, 98% should have 35 µg or less per 100 ml. of blood, and 100% should have 40 µg or less per 100 ml. of blood, as adequate indications that no health hazard due to lead absorbtion exists. The lead-in-blood level is now regarded as the sole valid criterion.

Accordingly, a further 204 children and infants were investigated, and blood levels determined. Haemoglobin levels were also checked.

The haemoglobin levels were found to be normal for age in all children and infants tested, and results of the 204 lead-in-blood tests showed that 100% had 40 µg or less per 100 ml. of blood, 98% had 35 µg or less per 100 ml. of blood, and 83% had 20 µg or less for 100 ml. of blood.

As a result of all the tests carried out in 1972 and 1973, no public health hazard due to abnormal absorption of lead could be demonstrated in the vicinity of the Sulphide Corporation lead smelter at Cockle Creek.

RECENT EPIDEMIOLOGICAL STUDIES ON ENVIRONMENTAL LEAD OF INDUSTRIAL ORIGINS

A.E. MARTIN, F.A. FAIRWEATHER, R.ST.J. BUXTON, L.M. ROOTS
Department of Health and Social Security, London, U.K.

ABSTRACT

During the past three years local Authorities in the United Kingdom have carried out ten epidemiological surveys in the vicinity of lead works. In four of these the proportion of children and sometimes of their mothers with raised blood lead levels and living in the vicinity of the works was higher than expected. The levels were highest close to the works. Further epidemiological studies showed also that the families of lead workers even when living some considerable distance from the works sometimes had markedly raised blood lead levels. In the latter the source of the raised lead intake was believed to be lead particles on the person or clothing of the workers notwithstanding the provision of changing and shower rooms at the works. In the case of families living in the immediate vicinity of the works the respective importance of the pathways by which lead was leaving the works could not be ascertained. High lead concentrations were found in the dusts within and in the vicinity of the houses and this was thought to be due in part to dust leaving the works on the footwear of employees and on vehicles and particularly on the wheels of vehicles. Some airborne or deposited lead derived from ventilation flues and chimneys would also be present. In nine of the ten works the filtration plant was in accordance with the requirements of the Alkali and Clean Air Inspectorate. The process used in the tenth works had not previously been regarded as constituting a serious source of pollution and the process had not therefore been placed under the supervision of the Inspectorate. Since heavy pollution was obviously coming from the works the factory management voluntarily agreed to the closure of the plant pending the installation of satisfactory filtration equipment.

Individuals with seriously raised blood levels were investigated further and in no case was any individual found with clinical symptoms of lead intoxication. The Departments of Employment and of Environment took immediate action to tighten pollution control and a Code of Practice has now been issued laying down methods by which pollution may be minimised. The surveys indicate the need for periodic checks to ensure the effectiveness of the anti-pollution measures adopted by industry.

VARIAZIONI DELL'ATTIVITA' ALA-DEIDRATASICA ERITROCITARIA IN RAPPORTO ALL'ETA' ED AL SESSO IN SOGGETTI NON PROFESSIONALMENTE ESPOSTI AL PIOMBO

G.C. SECCHI e L. ALESSIO

Clinica del Lavoro "Luigi Devoto", Milano, Italia

RIASSUNTO - Ricerche condotte su gruppi di popolazione non esposti a contatto con piombo per motivi professionali ed abitanti in grandi città industrializzate permettono di documentare che i livelli medi dell'attività ALA-deidratasica eritrocitaria sono significativamente più elevati nei soggetti di sesso femminile che in quelli di sesso maschile. Al contrario, i valori medi di piombemia sono meno elevati nelle donne che negli uomini. Nel corso di questa indagine sono stati anche determinati i valori medi dell'attività ALA-deidratasica eritrocitaria in gruppi di soggetti, appartenenti ai due sessi, nella primissima infanzia, nella seconda infanzia, nelle età giovanile, adulta, senile. I risultati ottenuti possono essere valutati in relazione ai seguenti parametri: sesso, età ed abitudini alimentari; infatti ciascuno dei gruppi esaminati può essere considerato sostanzialmente omogeneo in rapporto al parametro rappresentato dall'inquinamento ambientale da piombo, trattandosi di individui abitanti nella stessa città e non esposti a contatto con piombo per motivi professionali.

VARIATIONS IN THE ACTIVITY OF ALA-DEHYDRATASE IN RED BLOOD CELLS IN RELATION TO SEX AND AGE IN PERSONS NOT EXPOSED TO LEAD IN THE COURSE OF WORK

G.C. SECCHI and L. ALESSIO

Clinica del Lavoro "Luigi Devoto", Milano, Italy

SUMMARY - Research on population groups not occupationally exposed to contact with lead and living in large industrial conurbations, shows that average levels of ALA-dehydratase in red blood cells are significantly higher in female subjects than in males. On the other hand, average blood-lead levels are lower in women than in men. In the course of this research project, mean levels of ALA-dehydratase in red blood cells were measured in groups of infants, children, adolescents, adults and old people, of both sexes. The results obtained may be evaluated in relation to the following factors: sex, age and eating habits; in fact each of the groups examined could be considered basically homogeneous as regards ambient lead pollution, since the project covered individuals living in the same town who were not occupationally exposed to contact with lead.

SIGNIFICATION DES INDICATEURS BIO-ANALYTIQUES DE L'EXPOSITION AU PLOMB AU SEIN D'UNE POPULATION NON PROFESSIONNELLEMENT EXPOSEE

P. BRUAUX, F. CLAEYS-THOREAU, A. LAFONTAINE, M. LEGRAND,
R. DEBOECK, Y. SWYNGEDOUW

avec l'aide technique de Mmes M. MILISSEN-VANDE RIVIERE
et J. VERHOEVEN-DAULNE

Institut d'Hygiène et d'Epidémiologie,
Ministère de la Santé Publique, Bruxelles, Belgique

RESUME

Les principaux indicateurs bio-analytiques actuellement proposés pour l'exposition non professionnelle au plomb présent dans l'environnement sont la mesure de la plombémie, celle de la plomburie, celle de l'activité de la déhydratase de l'acide deltaaminolévulinique dans le sang circulant (ALA D) et celle de l'excrétion de l'acide deltaaminolévulinique dans les urines (ALA U). Les problèmes techniques posés par la plombémie et la plomburie en ce qui concerne la mesure des faibles teneurs que l'on peut rencontrer dans les expositions à la pollution saturnine de l'environnement ne sont pas encore entièrement résolus. Des programmes d'intercomparaison, organisés tant dans les pays de la Communauté Européenne que dans d'autres pays ont démontré à suffisance cette difficulté.

Au cours de la présente enquête épidémiologique, les auteurs se sont attachés à dégager la valeur de la mesure de l'ALA D et celle de l'excrétion de l'ALA U dans l'estimation des risques sanitaires que comporte la pollution de l'environnement par le plomb. Ils envisagent cette pollution dans son ensemble et non seulement sous l'angle particulier de la pollution de l'air par les gaz d'échappement des véhicules à moteur.

La population choisie n'est pas sélectionnée ni professionnellement exposée. Les personnes examinées peuvent être considérées comme étant en bonne santé; elles ont été réparties en divers groupes selon l'âge, le sexe, le lieu d'habitation, les habitudes tabagiques, etc ...

- Pour ce qui est de la mesure de l'ALA D, les auteurs ont utilisé une technique dérivée de celle de BONSIGNORE.
  La méthode d'analyse utilisée s'écarte quelque peu de la méthode communautaire standardisée en voie d'élaboration. Les résultats obtenus avec les deux techniques semblent toutefois assez semblables.

- Pour l'excrétion de l'ALA U, les auteurs ont utilisé la méthode classique de DAVIS : séparation chromatographique de l'ALA présent dans les urines puis dosage colorimétrique du porphobilinogène formé après addition d'acétylacétone. Les résultats sont exprimés en mg d'ALA excrété par gramme de créatinine afin d'éliminer les différences dues au volume de la diurèse.

Les auteurs ont également effectué des dosages de la plombémie et en comparent les résultats avec ceux des mesures de l'ALA D et de l'ALA U.

./.

Les résultats ont été soumis à une analyse statistique qui a permis de tirer les principales conclusions suivantes :

1. Il n'y a aucune corrélation statistiquement significative entre les dosages d'ALA D et d'ALA U dans les divers groupes de population.
2. Les différences observées dans la mesure de l'ALA U pour les divers groupes de population considérés ne sont pas fortement significatives et pourraient, peut-être, être expliquées par des modifications du métabolisme d'excrétion.
   L'excrétion de l'ALA U n'apparaît pas un test valable pour déceler l'exposition non professionnelle au plomb. Ces valeurs d'ALA U sont en effet inférieures à celles considérées comme signe d'alerte en médecine du travail.
3. La mesure de l'ALA D dans le sang circulant a, par contre, permis de dégager des corrélations hautement significatives.
   a. l'activité de l'ALA D diminue avec l'âge : cette constatation est probablement à mettre en corrélation avec le "total body burden" en plomb qui augmente avec l'âge;
   b. l'activité de l'ALA D est plus élevée chez les femmes que chez les hommes : cette constatation pourrait également être mise en corrélation avec la différence de la plombémie observée par certains auteurs entre hommes et femmes;
   c. l'activité de l'ALA D est nettement diminué chez les fumeurs. Ici également, cette différence pourrait être mise en corrélation avec la plombémie plus élevée chez les fumeurs;
   d. par contre, il n'y a aucune différence significative entre l'activité de l'ALA D chez les citadins et les personnes habitant en zone rurale. Il faut cependant souligner que la plupart des personnes qui ont été examinées et considérées comme rurales par leur habitat avaient leur lieu de travail en zone urbaine.

En conclusion, les auteurs estiment que la mesure de l'ALA D dans le sang circulant, associée à une mesure de la plombémie, représente un des indicateurs bio-analytiques acceptable de l'exposition à la contamination par le plomb en provenance de l'environnement et utile pour établir des enquêtes épidémiologiques.

IMPORTANCE OF BIO-ANALYTICAL INDICATORS OF LEAD EXPOSURE IN SECTIONS OF THE POPULATION NOT EXPOSED TO LEAD AT WORK

P. BRUAUX, F. CLAEYS-THOREAU, A. LAFONTAINE, M. LEGRAND,
R. DEBOECK AND Y. SWYNGEDOUW

Technical assistance provided by Mrs. M. MILISSEN-VANDE RIVIERE
and Mrs. J. VERHOEVEN-DAULNE

Institute of Hygiene and Epidemiology,
Ministry of Public Health, Brussels, Belgium

SUMMARY - The main bio-analytical indicators currently suggested for testing non-occupational exposure to lead in the environment are measurements of lead in the blood, lead in the urine, the activity of the dehydratase of deltaaminolevulinic acid in the blood as it circulates (ALA D) and the excretion of deltaaminolevulinic acid in urine (ALA U). The technical problems of measuring the small amounts of lead which may be found in the blood and urine after exposure to lead pollution in the environment have not yet been completely solved. Comparative programmes organised both within the European Community and in other countries have produced sufficient evidence of the difficulties involved.

During this epidemiological survey, the authors attempted to determine the value of ALA D measurements and those of the excretion of ALA U in assessing health risks from lead pollution of the environment. They considered this kind of pollution as a whole and did not concentrate only on the specific problem of air pollution caused by exhaust gases from motor vehicles.

The sections of the population chosen for the survey were not specially selected nor exposed to lead at work. The subjects examined may be considered to have been in good health. They were divided into various groups according to age, sex, place of residence, smoking habits etc. ...

-The authors used a technique derived from that of Bonsignore for measuring the ALA D.
The analytical method used is slightly different from the standardised Community method currently being worked out, but the results obtained in both cases appear quite similar.

-The authors used the conventional Davis method for the excretaion of the ALA U; separation of the ALA in the urine by chromatography, followed by colorimetric analysis of the porphobilinogen formed after addition of acetylacetone. The results were expressed in mg of ALA excreted per gramme of creatinine in order to eliminate any differences due to the volume of diuresis.

./.

The authors also carried out analyses of lead in the blood and compared the results with those of the ALAD and ALAU measurements. The results were then analysed statistically, and the following conclusions drawn:

1. There is no significant statistical correlation between the analyses of ALA D and ALA U in the various population groups.

2. The differences observed in ALA U measurements in the various population groups studied are not very significant and could perhaps be explained by changes in excretory metabolism. The excretion of the ALA U does not appear to be a valid test for revealing non-occupational exposure to lead. The values of ALAU found were in fact lower than those considered by works doctors to be a warning signal.

3. On the other hand, measurements of ALA D in the blood in circulation provided highly significant correlations.

   a) the activity of the ALA D decreases with age: a correlation can probably be established here with the total lead body burden which increases with age;

   b) the activity of the ALA D is greater in women than in men: a correlation could probably be established here also with the difference in blood lead levels observed by certain authors in men and women;

   c) the ALA D is clearly less active in smokers. In this case also, a correlation could be established with the higher blood lead level in smokers;

   d) in contrast, there is no significant difference between the activity of the ALA D in town-dwellers and in people living in rural areas. It should, however, be emphasised that most of those examined who were considered as living in rural areas worked in urban areas.

In conclusion, the authors consider that measurements of ALA D in the blood in circulation, taken together with measurements of blood lead levels, are an acceptable bio-analytical indicator of the exposure to lead contamination from the environment, and are useful for the purposes of epidemiological surveys.

IMPORTANCE OF BIO-ANALYTICAL INDICATORS OF LEAD EXPOSURE IN SECTIONS OF THE POPULATION NOT EXPOSED TO LEAD AT WORK

P. BRUAUX, F. CLAEYS-THOREAU, A. LAFONTAINE, M. LEGRAND,
R. DEBOECK AND Y. SWYNGEDOUW

Technical assistance provided by Mrs. M. MILISSEN-VANDE RIVIERE
and Mrs. J. VERHOEVEN-DAULNE

Institute of Hygiene and Epidemiology,
Ministry of Public Health, Brussels, Belgium

SUMMARY - The main bio-analytical indicators currently suggested for testing non-occupational exposure to lead in the environment are measurements of lead in the blood, lead in the urine, the activity of the dehydratase of deltaaminolevulinic acid in the blood as it circulates (ALA D) and the excretion of deltaaminolevulinic acid in urine (ALA U). The technical problems of measuring the small amounts of lead which may be found in the blood and urine after exposure to lead pollution in the environment have not yet been completely solved. Comparative programmes organised both within the European Community and in other countries have produced sufficient evidence of the difficulties involved.

During this epidemiological survey, the authors attempted to determine the value of ALA D measurements and those of the excretion of ALA U in assessing health risks from lead pollution of the environment. They considered this kind of pollution as a whole and did not concentrate only on the specific problem of air pollution caused by exhaust gases from motor vehicles.

The sections of the population chosen for the survey were not specially selected nor exposed to lead at work. The subjects examined may be considered to have been in good health. They were divided into various groups according to age, sex, place of residence, smoking habits etc. ...

-The authors used a technique derived from that of Bonsignore for measuring the ALA D.
The analytical method used is slightly different from the standardised Community method currently being worked out, but the results obtained in both cases appear quite similar.

-The authors used the conventional Davis method for the excretaion of the ALA U; separation of the ALA in the urine by chromatography, followed by colorimetric analysis of the porphobilinogen formed after addition of acetylacetone. The results were expressed in mg of ALA excreted per gramme of creatinine in order to eliminate any differences due to the volume of diuresis.

./.

The authors also carried out analyses of lead in the blood and compared the results with those of the ALAD and ALAU measurements. The results were then analysed statistically, and the following conclusions drawn:

1. There is no significant statistical correlation between the analyses of ALA D and ALA U in the various population groups.

2. The differences observed in ALA U measurements in the various population groups studied are not very significant and could perhaps be explained by changes in excretory metabolism. The excretion of the ALA U does not appear to be a valid test for revealing non-occupational exposure to lead. The values of ALAU found were in fact lower than those considered by works doctors to be a warning signal.

3. On the other hand, measurements of ALA D in the blood in circulation provided highly significant correlations.

    a) the activity of the ALA D decreases with age: a correlation can probably be established here with the total lead body burden which increases with age;

    b) the activity of the ALA D is greater in women than in men: a correlation could probably be established here also with the difference in blood lead levels observed by certain authors in men and women;

    c) the ALA D is clearly less active in smokers. In this case also, a correlation could be established with the higher blood lead level in smokers;

    d) in contrast, there is no significant difference between the activity of the ALA D in town-dwellers and in people living in rural areas. It should, however, be emphasised that most of those examined who were considered as living in rural areas worked in urban areas.

In conclusion, the authors consider that measurements of ALA D in the blood in circulation, taken together with measurements of blood lead levels, are an acceptable bio-analytical indicator of the exposure to lead contamination from the environment, and are useful for the purposes of epidemiological surveys.

DIAMETRE ERYTHROCYTAIRE MOYEN CHEZ LES ADULTES HABITANT UNE VILLE AVEC UNE ATMOSPHERE POLLUEE PAR LE PLOMB ANORGANIQUE DE SOURCE INDUSTRIELLE

NAUM W. GHELBERG, EMERIK BORDAS

Institut de Santé Publique et de Recherches Médicales,
Cluj, Roumanie

RESUME

Dans le cadre d'études concernant l'influence du plomb sur l'hématopoïèse nous nous sommes proposés d'examiner aussi le comportement du diamètre erythrocytaire moyen (DEM; µ) chez les adultes d'une ville avec une atmosphère polluée par le plomb anorganique (teneur moyenne ≤ 4,6 µg Pb/mc d'air - échantillonages de 24 heures) de source industrielle (métallurgie non-ferreuse). Un nombre de 359 sujets non exposés professionnellement au plomb (groupe P) furent examinés comparativement à deux groupes témoins: groupe T, comportant 115 témoins sans symptômes cliniques de maladie, résidant dans d'autres villes (< 1 µg Pb/mc air) et groupe O, comportant 100 ouvriers professionnellement exposés au plomb, toutefois sans symptômes cliniques.

Chez les 5 séries de sujets constituant le groupe P, la valeur moyenne $(\bar{x}_p \pm s)$ du DEM fut constatée égale à 7,76 ± o,64, alors que chez les sujets des 5 séries constituant le groupe T, la valeur moyenne fut moins élevée (7,o6 ± o,49). Pour le groupe O cependant, la moyenne fut encore plus élevée (8,oo ± o,24). La tendance d'accroissement et la signification statistique marquée ($p<o,ol$) des différences constatées par nous entre les diverses valeurs moyennes de ces 3 groupes (T - P - O), témoignent d'une corrélation existant entre les dimensions DEM et la teneur en plomb de l'environnement.

L'allure des courbes de type Price-Jones s'est avérée différente pour les 3 groupes étudiés. Il est à noter que l'allure de chaque courbe fut obtenue en totalisant le nombre d'érythrocytes mesurés pour chacun des groupes (1oo x le nombre des sujets). Les aspects ainsi obtenus sont caractérisés par la classe des dimensions qui comprennent la fréquence pourcentuelle maximale, et par une baisse du peak et un glissement vers la droite et la présence d'une traîne vers la droite, allant du T vers le P, d'autant plus marquée pour le O.

./.

Les faits ci-dessus démontrent que l'influence prolongée du contact avec le plomb environnant détermine une tendance vers la macrocytose chez la population adulte exempte de signes cliniques, tendance qui s'accentue parallèlement avec l'intensification de l'exposition.

On suggère que l'étude du DEM pourrait servir en tant que méthode de screening pour le diagnostic en groupe de l'exposition au plomb chez les groupes de population habitant des zones urbaines avec des degrés différents de pollution par le plomb.

MEAN ERYTHROCYTE DIAMETER IN ADULTS LIVING IN AN URBAN ATMOSPHERE POLLUTED BY INORGANIC LEAD FROM INDUSTRIAL SOURCES

NAUM W. GHELBERG AND EMERICK BORDAS

Institute of Public Health and Medical Research, Cluj, Rumania

SUMMARY - As part of our studies on the effect of lead on hemato- the behaviour of the mean erythrocyte poiesis, we decided to examine diameter (MED; μ) in the adult population of a town whose atmosphere was polluted by inorganic lead (mean content ≤ 4.6 μg Pb/mc air - samples taken every 24 hours from industrial sources (non-ferrous metal works). 359 subjects not exposed to lead during the course of their work (group P) were examined and results compared with those of two control groups: groupt T, comprising 115 subjects with no clinical symptoms of illness, living in other towns (< 1 μg Pb/mc air) and group O, comprising 100 workers exposed to lead during the course of their work, but showing no clinical symptoms.

In the 5 series of subjects comprising group P, the mean value ($\bar{x}_P \pm s$) of the MED was found to be equal to 7.76 ± 0.64, whereas in the subjects of the 5 series comprising group T, the mean value was not so high (7.06 ± 0.49). In group O, however, the mean was even higher (8.00 ± 0.24). The tendency towards increased MED values and the marked statistical significance ($p < 0.01$) of the differences observed between the various mean values of these 3 groups (T - P - O) show that a correlation exists between the size of the MED and the lead content of the environment.

The appearance of the Price-Jones curves was different for each of the 3 groups studied. It should be noted that each curve was obtained by totalling the number of erythrocytes measured for each of the groups (100 x the number of subjects). The shapes obtained in this way were characterised by size category including the maximum percentage frequency, by a drop in the level of the peak, a displacement to the right and a gradual lengthening of the curve to the right, from T towards P, and even more marked in the case of O.

The above facts show that the prolonged effects of contact with lead in the environment are a tendency towards macrocytosis in the adult population showing no clinical signs, which increases as exposure becomes more intense.

It is suggested that a study of the MED could act as a screening method for group diagnosis of lead exposure in population groups living in urban areas with different degrees of lead pollution.

PREVALENCE OF SUBCLINICAL LEAD EXPOSURE IN 761 ASYMPTOMATIC SCHOOL CHILDREN : DENTINE LEAD LEVELS AS A RETROSPECTIVE MARKER

*HERBERT L. NEEDLEMAN AND **IRVING SHAPIRO

*Department of Psychiatry Harvard Medical School,
Children's Hospital Medical Center Boston, U.S.A.

**Center for Oral Health Research,
University of Pennsylvania, U.S.A.

ABSTRACT

Dentine lead concentrations have been shown to be markedly and consistently elevated in children with known exposure to lead years after acute toxicity has ceased. This tissue is a reliable marker of past exposure, when other, more transitory indices have returned to normal, and permits the conduct of large scale epidemiologic studies in which the relationship between subclinical exposure and neuropsychologic deficit can be measured.

761 shed deciduous teeth from asymptomatic Philadelphia school children were collected, the circumpulpal dentine dissected out and lead concentrations measured by anodal stripping voltammetry. The mean dentine lead levels from white children whose housing was relatively new was 40 µg/g. Three percent of these children had levels greater than 100 µg/g. The mean tooth lead level for black children living in deteriorated housing was 180 µg/g. Sixty-six percent of these children had tooth lead levels greater than 100 µg/g; and 20 percent had levels in the range found with clinical lead poisoning.

A group of 71 white children whose housing was in good repair, but who attended school adjacent to a major lead processor had marked elevations of dentine lead concentration (mean=136 µg/g), with some values among the highest measured in the study. Nine percent had levels in the range previously found with clinical lead poisoning.

Dust and dirt samples collected from the schools in each district tended to parallel the dentine lead levels.

The data show a higher prevalence of serious exposure than previously reported. They also demonstrate that in addition to lead paint from deteriorated housing, airborne lead is a significant source for some populations and that in addition to ghetto dwellers, other groups of children may be considered at risk.

LEAD ETHANOL AND δ-AMINOLAEVULINIC ACID DEHYDRATASE

MICHAEL R. MOORE

Department of Materia Medica,
Stobhill General Hospital, Glasgow, U.K.

ABSTRACT

It has long been accepted that lead has a direct effect upon Haem biosynthesis (Goldberg, 1972). In particular lead has been shown, both by direct studies of activity and also by measurement of excreted urinary δ-aminolaevulinic acid (ALA), to markedly inhibit ALA dehydratase (EC, 4, 2, 1, 24) the second enzyme in the haem biosynthetic pathway. Similarly acute ethanol intoxication depresses the activity of ALA dehydratase. When normal subjects consumed whisky, blood ALA dehydratase activity was depressed as blood ethanol concentrations rose to a maximum and rose pari-passu with depression of blood ethanol levels (Moore et al, 1971). In chronic alcoholics blood ALA dehydratase activity is also depressed even when blood ethanol concentrations are zero, normal activity only being regained after about one week's abstention from ethanol (Krasner et al, 1973).

In the rat experiments now described, the effects of ethanol and lead separately and together, were examined. Blood ethanol concentrations were measured by gas liquid chromatography; blood lead concentrations of graphite furnace atomic absorption spectrophotometry and blood ALA dehydratase activity by the methods of Moore et al (1971) and the Commission of European Communities (CEC) standardised method (1973), both being expressed finally as μmole ALA used per minute per litre of blood (units of ALA.D). Liver ALA.D was measured by the method of Moore et al (1971) and expressed as μmole ALA per g. wet weight tissue per minute.
Results are shown as mean ± SD.

Significant depressions of ALA dehydratase were observed at mean blood lead concentrations of 132 ± 38 μg/100ml whole blood and at mean blood ethanol concentrations of 194 ± 41 mg/100ml whole blood. When these were combined at similar concentrations of 123 ± 60 μg lead/100ml whole blood and 189 ± 34 mg ethanol per 100.ml whole blood, the activity of ALA dehydratase was significantly elevated over the two separate depressed activities though lower than the initial control value.

In a subsequent experiment in vitro, with a rat liver as a source of the enzyme, it was found that ALA dehydratase activity was again depressed by both ethanol and lead separately but elevated by these compounds together. The linking factor in both these experiments seems to be the concentration of reduced glutathione (GSH) in the system. Lead is known to bind to thiol groups, and other workers have shown that the addition of GSH to systems in which ALA dehydratase activity is being measured minimizes the depression of activity due to lead (de Barriero, 1969). Conversely, although GSH is a cofactor for ALA dehydratase, excessive concentrations of GSH lower the activity of the enzyme (Moore et al, 1972). Ethanol oxidation substantially alters the redox potential of the cell and, in doing so, alters the (GSH/GSSG) ratio in the cell. It is therefore suggested that, although

./.

lead depresses GSH concentrations and thus lowers dehydratase activity, and ethanol raises GSH concentrations and lowers the activity, these two in conjunction act in opposite directions and thus cause an effective maintenance of activity.

de BARRIERO, O.C. (1969)
Biochem. Pharmacol. 18 2267-2271

GOLDBERG, A. (1972)
Brit. J. Haemat. 23 521

KRASNER, N., MOORE, M.R., THOMPSON, G.G., MCINTOSH, W. & GOLDBERG, A.
(1973) Clin. Sci. - In Press

MOORE, M.R., BEATTIE, A.D., THOMPSON, G.G. & GOLDBERG, A. (1971)
Clin. Sci. 40 81-88

THE USE OF TRACER TECHNIQUES AND ENVIRONMENTAL SOURCES FOR EVALUATION OF THE LEAD PROBLEM IN CHILDREN

*GARY TER HAAR AND **REGINE ARONOW

*Ethyl Corporation, Research Laboratories, Detroit, U.S.A.
**Children's Hospital of Michigan, Detroit, U.S.A.

ABSTRACT

There are many references in the literature to the fact that children, especially those in the United States, living in deteriorated housing, have a problem with lead poisoning. Eating leaded paint has been recognized as the prime cause of lead poisoning and elevated blood leads. Recently there has been speculation that children may eat dust and dirt containing lead exhausted from automobiles and that this may contribute significantly to the childhood lead problem.

This paper compares lead in paint on houses with lead from the automobile as a source of lead in dirt and proposes a new tracer technique to evaluate whether children eat dust and air suspended particulate.

In the first part of the study we looked at lead in soil around old painted houses in the city and around old houses in rural areas remote from traffic. The concentration and distribution of lead around these houses was nearly identical with the highest concentrations near the houses. Thus it is clear that lead in dirt around the houses was due to paint from these houses and that lead antiknocks were not a significant contributor.

The second part of this study is a new approach to estimating the ingestion of dust and airborne particulate. A naturally occurring radioactive tracer (lead-210) was used to determine the relative amounts of dust and other lead containing materials such a paint, eaten by the children. Analysis of paint samples showed very low levels of lead-210, while dust samples contained at least 100 times as much lead-210. Dirt samples also show elevated lead-210 concentrations.

Stable lead and lead-210 were measured in the excreta of children suspected of having elevated body burdens of lead and in children living in good housing where lead poisoning is not a problem. The children suspected of having elevated body burdens of lead excreted much more lead than the normal children. Despite the differences in fecal leads between the groups the excretion of lead-210 was essentially the same. These results do not support the hypothesis that children eat dust and air suspended particulate.

POLLUTANT-ORIENTED INTEGRATED MONITORING SYSTEMS AND EXPOSURE ASSESSMENT

E.A. SCHUCK, G.B. MORGAN, D.S. BARTH

National Environmental Research Center
Office of Research and Development
U.S. Environmental Protection Agency, Las Vegas - U.S.A.

ABSTRACT -
Recognition of the existence of an environmental pollution problem often does not occur until the impact on man is relatively serious both in intensity and in extent of exposure. Coincident with recognition is the demand for immediate solutions. This demand is inconsistent with the multiyear effort usually required by research monitoring to acquire accurate data on which to form a sound basis for standards. Thus, control actions are sometimes based on inadequate information which may result in solutions changing the nature of the problem but not solving it.

Present approaches to some types of environmental pollution control may be wasteful of resources and unless redirected may compound environmental problems. Required is a systems approach which examines singly and in combination, all relevant factors including specifically all significant sources of exposure to important populations of receptors. With this in mind, we are developing pollutant-oriented integrated monitoring systems. Such a system quantitates the movement, interactions, and pathways from sources to the most sensitive populations of receptors in all media for the purpose of assessing total exposure. Quality assurance of the individual components will be developed in the basic plan as an overall part of the system. Thus, questions such as, why are we monitoring, why is the data base needed, etc., will be addressed in addition to questions about measurement methods and precision.

Conceptually the components and interrelationships of such a system can be outlined for the general case of an environmental pollutant. However to bring this down to specific guidelines and recommendations requires examination of the real world. This is proceeding in two subject areas. The first is an examination of the detail with which a presumably well investigated subject, i.e., exposure to environmental lead, can be described in a quantitative fashion. The second area is examination of existing monitoring systems and data bases in order to delineate their usefulness, cost effectiveness, and applicability. There are multistation networks generating data for specific environmental pollutants throughout

./.

the world. Yet data are not necessarily information and the questions we are addressing will determine what information has been reliably extracted from the data and what additional information can be extracted.

Progress in quantitating lead exposures to a selected population of human receptors, the historical consequences of a limited rather than a comprehensive approach to environmental pollution control, and examples of extracting exposure-dose relationships from existing data bases are reported.

INTEGRATED ASSESSMENT OF HEALTH EFFECTS OF AIR POLLUTION

*LYNDON R. BABCOCK, Jr., *NIREN L. NAGDA, **AUGUST T. ROSSANO

*University of Illinois, **University of Washington
USA

ABSTRACT - This presentation is directed to individuals who seek a methodology for integrating air quality with population exposure and health effects.

First, a comprehensive system of indices is described which relates population exposure and health-related damage back to individual sources. The system permits a ranking of source severity and at the same time enables improvement of the experimental design of health effect studies.

Second, we describe use of "personal" pollution monitors in attempts at verification of population exposure models.

The prime purpose of most air quality management strategies is to reduce the health risk to exposed human populations. The situation is complex with many kinds of sources, pollutants, and human receptors, all tied together by uncertain source-receptor pathways. Thus, techniques for sampling and analysis of pollutant levels and for developing cause-effect relationships, although essential, are not in themselves sufficient to develop an optimal health-related air quality management strategy.

Much needed is an overall integrated assessment of health risk which is directly related to population exposure. Some of the important, but usually overlooked considerations, include the changing environment of the receptor (inside versus outside buildings and vehicles), pollutant synergisms, pollutant decay, short-term versus long-term exposure, and different degrees of risk in individual population categories (old versus young and healthy versus sick). Inclusion of these considerations can multiply the utility of monitoring, epidemiological, and toxicological studies.

Some past efforts toward integrated assessment have attempted to apply economic yardsticks and/or air pollution indices to health-effect questions, and such studies have provided valuable insight. However, much more needs to be done in concert with the ever-increasing generation of basic health-effect information.

This presentation describes our extensions of past efforts toward development of an integrated methodology. Our research is continuing with financial support largely supplied by the U. S. Environmental Protection Agency, the U. S. National Science Foundation, and Argonne National Laboratory.

MEXICO CITY'S PINDEX LEVEL

H. BRAVO A., M.E. ESPINOSA, A.C. LOWE, S. SALAZAR

Instituto de Geofisica, Universidad Nacional Antoaoma, Mexico

---

ABSTRACT - Up to now, an attempt has not been made in the sense of evaluating Mexico City's air pollution in a total, more comprehensive way, where concentration as well as tolerance limits are interrelated. Also, the effect of solar radiation has never been considered as a direct parameter in the dynamics of the air pollution problem.

We strongly believe that the solar radiation has to be considered if a good understanding of the air pollution is desired, due to the very special location of Mexico City, such as altitude, 2,268 m. above sea level, and the latitude, 19°20' north.

The use of the Pindex approach gives a very strong support to epidemiological and health effects to be expected as a result of air pollution.

A METHOD FOR SIMULATING THE TRUE HUMAN EXPOSURE OF CRITICAL POPULATION GROUPS TO AIR POLLUTANTS

WAYNE R. OTT (*) DAVID T. MAGE (**)

(*)EPA, office of Research and Development, Washington D.C. USA
(**) San Jose State University, San Jose, California, USA

ABSTRACT - There are serious problems in obtaining an accurate assessment of the true population exposure to air pollutants. In the United States, the primary means for monitoring air quality is by measurements at fixed locations in urban areas, or *air monitoring stations*. It is becoming increasingly apparent that data from such stations provide a relatively poor measure of the true exposure of members of the general public to air pollutants, because these stations are not necessarily located where the public is exposed to the highest concentrations.

To demonstrate a method to obtain a more representative measure of the human exposure of a critical population group — pedestrians and shoppers — a technique was developed for simulating the true exposure of pedestrians to carbon monoxide (CO) by collecting integrated CO samples over the routes that they walk. A total of 438 of these *simulated exposure samples* (SES) were collected on congested downtown streets in a major urban area. The results were compared statistically with conventional measurements from a nearby fixed monitoring station. Significant differences were observed between these two sampling methodologies — fixed and SES — and the significance of these findings for future health-related research investigations is discussed.

PERSONAL AND INDOOR EXPOSURE METERS

A. P. ALSHULLER, A. E. O'KEEFFE

Chemistry and Physics Laboratory
National Environmental Research Center, Research Triangle Park, N. C. USA

ABSTRACT - In recent years there has been considerable increased emphasis on the development, evaluation and standardization of instruments for monitoring pollutants in fixed or mobile sites. Community health studies have had to utilize these types of monitoring results to relate to pollutant exposures of individual subjects. Pollutant exposures over 24 hour periods involve exposure not only to community pollutant concentrations, but also to commuter and indoor pollutant concentration levels. The exposures of a discrete and mobile group of subjects to community pollutant concentration levels also may not be readily derived from monitoring results at a limited number of fixed sites.

The limitations in the present situation can be resolved by the development of small portable instruments "exposure meters" for measuring an individual's exposure to air pollutants. The individual in the study could carry the instrument and operate it at home, in a vehicle, office, laboratory, etc. Projects are being developed by the Chemistry and Physics Laboratory, National Environmental Research Center, RTP, for exposure meters and as an alternative simple portable samplers. Emphasis will be on measuring nitrogen oxides, sulfur oxides and oxidant. Because of the available capability to do carbon monoxide in blood samples, there is no current need for a device for carbon monoxide. Particulate species such as sulfate and nitrate probably would be collected on appropriately designed mini-samplers. A state of the art survey will be prepared, particularly concerned with fine particulate species, noise and other toxic environmental pollutants. This document will be used to develop the longrange program on exposure meters in the U. S. Environmental Protection Agency. The status of available personal monitors for physiological parameters will be evaluated by the Human Studies Laboratory, National Environmental Research Center, Research Triangle Park, N. C.

DIE AUTOMATISCHE UEBERWACHUNG DER KRAFTFAHRZEUGABGAS-IMMISSION IM ARBEITS- UND WOHNBEREICH

DIETER JOST

Institut für Meteorologie und Geophysik, Frankfurt, B.R.D.

KURZFASSUNG - Ein vollautomatisches Meßnetz zur Ueberwachung der Luftverunreinigung im Arbeits- und Wohnbereich der Stadt Frankfurt wird, ausgehend von den Erfahrungen bei der Schwefeldioxidüberwachung, zur Ueberwachung der kraftfahrzeugbedingten Abgase erweitert. Aufbauend auf langjährigen Meßreihen verschiedener meteorologischer Größen und von Luftverunreinigungen werden mit Hilfe von Abschätzungen atmosphärischer Ausbreitungsvorgänge die Luftverunreinigungsmeßdaten bzw. Daten der Luftverunreinigungsdosis für die Bewohner des betrachteten Raumes ermittelt.

Folgende Komponenten werden dabei erfaßt :

SO_2, CO, NO_x, Oxidantien, Gesamtstaub, Blei und weitere Metalle im Staub.

Mit Hilfe der Untersuchung der Korrelation verschiedener Luftverunreinigungen ist es möglich, die Zahl der Meßstellen und die Zahl der zu untersuchenden Komponenten zu optimieren, wobei die Anforderungen folgender Untersuchungsziele zu berücksichtigen sind :

Flächen- und zeitbezogene Belastung mit Luftverunreinigungen, Trend verschiedener luftverunreinigender Komponenten, Smog-Warnung, Optimierung von Meßnetzen, Daten für epidemiologische Untersuchungen.

Aus diesen Aufgabenbereichen werden Untersuchungsergebnisse mitgeteilt, die auch eine Bilanzierung von Belastung durch Luftverunreinigungen und Erholung in Ballungsgebieten gestatten.

AUTOMATIC MONITORING OF VEHICLE EXHAUST EMISSIONS IN INDUSTRIAL AND RESIDENTIAL AREAS

DIETER JOST

Institut für Meteorologie und Geophysik, Frankfurt,
Federal Republic of Germany

Abstract: A fully automatic network for monitoring atmospheric pollution in the industrial and residential areas of Frankfurt is being extended to include vehicle exhaust gases, after experience with sulphur dioxide monitoring. On the basis of meteorogical and pollution measurements made over several years, pollution data and data on the exposure of inhabitants of the area under survey to pollution will be determined by using estimated atmospheric spread patterns.

The substances measured are: -

> SO_2, CO, NO_x, oxidising agents, total dust, lead and other metals in the dust.

By investigating the correlation between different pollutants it is possible to optimise the number of measuring points and also the number of elements to be examined; the conditions governing the following items to be examined, must be considered: -

> Area - and time - related pollution levels, patterns of different pollutants, smog warning, the optimising of monitoring networks, and data for epidemiological investigations.

This type of data will produce results which also make it possible to draw up a balance sheet of pollution and anti-pollution factors in densely populated areas.

INCORPORATION OF POPULATION EXPOSURE CONCEPTS IN AIR QUALITY CRITERIA DOCUMENTS

A. C. STERN, Y. HORIE

Department of Environmental Sciences and Engineering, School of Public Health, University of North Carolina, Chapel Hill, N.C., U.S.A.

ABSTRACT - The paper will explore the use of computed pollutant concentration isopleths to define the population of people, animals, vegetation and materials exposed to various pollutant levels as a possible element in air quality criteria documents. The concepts of percentile distribution population dose, integrated dose and the different averaging times request for evaluation of different receptor types will be discussed.

ESTABLISHING SAFE AMBIENT AIR QUALITY LEVELS FOR EIGHTEEN HAZARDOUS POLLUTANTS

SANDRA L. WILCOX, EDWIN L. KEITZ, LINDA J. DUNCAN

The Mitre Corporation 1820 Dolley Madison Boulevard
McLean, Virginia 22101 U.S.A.

ABSTRACT - The central objective of this study was to provide data for the development of safe ambient air quality levels for eighteen hazardous pollutants, including thirteen metals, asbestos, boron, chlorine, fluorides and selenium. This proposed safe level for each pollutant was then compared with the magnitude and geographical pervasiveness of that pollutant to provide insight for planning and developing hazardous pollutant control technology. An additional value of these proposed safe concentrations is to provide input to the current U.S. Government effort to establish official safe levels of pollutants in the air.

The principal effort in gathering the data for developing safe levels consisted of an in-depth investigation conducted through personal contact with twenty-three recognized experts in the epidemiology of air pollution from the medical and public health professions. The investigations with these experts were designed to provide the most current integrated opinion on this subject. An analysis and discussion of the results are presented and the specific health effects associated with each pollutant are identified. In addition, a comparison is shown between these results and ambient air quality standards which have been established by several foreign nations and various states in the U.S.A.

A comparison among the tonnage of pollutant emitted, the population in areas adjacent to the major emitter, and the safe ambient air quality level was made in order to indicate priorities which should be established for research and development of control technology for these pollutants.

A METHOD FOR THE IDENTIFICATION OF ENVIRONMENTAL NOISE LEVELS REQUISITE TO PROTECT PUBLIC HEALTH AND WELFARE

*SIMONE L. YANIV, **HENNING VON GIERKE,

*U. S. Environmental Protection Agency Washington, D.C. U.S.A.
**U. S. Air Force Dayton, Ohio U.S.A.

ABSTRACT - This paper deals with a variety of noise environments and noise exposures affecting the public and proposes a uniform, clearly defined and measurable index of environmental noise to describe and measure noises regardless of their origin and places of occurrence. The methodology proposed applies to all types of noise including that from aircraft, traffic, construction or other machinery, as well as noise from community or homes. It is utilized for the description of the noise environment of workplaces, public places and recreational or residential areas. The result is an environmental noise quality index which condenses the acoustical information into a single indicator of environmental noise similar to an air pollution index. This measure correlates well with overall long-term health and welfare effects of noise.It also correlates well with other noise measures and can be used uniformly to identify levels of environmental noise quality requisite to protect public health and welfare. This same measure is applied to many human exposure situations, thus allowing for the assessment of the cumulative noise exposure encountered by various populations as they move through various environments in the course of their life. This concept of cumulated integrated human exposure to environmental noise applied to various life styles of the population, serves as the basis for the identification of maximum noise exposure dose for individuals and maximum environmental noise levels at various places.

The levels identified are safe levels for protection of public health and welfare with an adequate margin of safety that includes medically susceptible persons.

RELATIONSHIP BETWEEN ACUTE RESPIRATORY ILLNESS AND AIR POLLUTION LEVELS IN AN INDUSTRIAL CITY

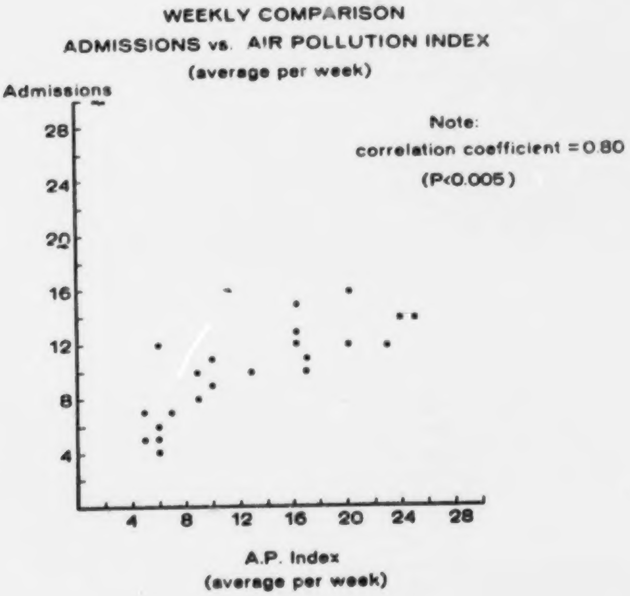
D. LEVY, M. GENT, M. NEWHOUSE

Respiratory Unit, St. Joseph's Hospital and McMaster University
Medical Centre, Hamilton, Ontario, Canada

ABSTRACT - A retrospective study relating hospital admissions for acute exacerbations among adults with chronic respiratory illness, and among children with acute respiratory disease, to air pollution levels was carried out in a highly industrialized Canadian city.

Two thousand patient records were collated and daily, weekly and monthly averages for admissions to hospital were related to a contemporary standard air pollution index (A.P.I.) which takes into account particulate matter and SO_2. A correlation coefficient of 0.53 ($P<0.10$) was found for the city as a whole, but the relationship was more marked where industry was most concentrated. Admission data from the hospital closest to the industrialized area showed a much higher correlation coefficient with A.P.I. (0.80, $P<0.05$) (fig. 1)

Thus there is a strong relationship between A.P.I. and hospital admissions due to respiratory illness in a susceptible population.



(Supported by National Health Grant No. 215-6225 Government of Canada)

ENVIRONMENTAL CONTAMINATION BY AUTOMOTIVE LEAD

HARRY W. EDWARDS

Department of Mechanical Engineering Colorado State University
Fort Collins, Colorado, USA

ABSTRACT - For the past four years, a team of researchers at Colorado State University has been studying environmental effects of automotive lead. This paper reports the significance of some of the major findings of that study. The extent and significance of environmental contamination by automotive lead, both in terms of effects on human health and environmental effects, have recently come under intensive investigation in a number of countries where continued use of lead as a gasoline additive is controversial.

The CUS study focuses upon characterizing short-range dispersal of automotive lead from traffic in both urban and rural settings. Measurements of airborne lead as a function of meteorological parameters, time, and traffic flow along Interstate 25 in Colorado have been incorporated into a line-source model which includes vertical wind shear and gravitational settling of lead-containing particles. The result is that, given the traffic flow and certain meteorological data, rural exposures nearby highways can be predicted with a high degree of accuracy. In the urban setting, dispersal of automotive exhaust is strongly influenced by local geometry and meteorology, and no fully satisfactory mathematical model is presently available. The approach was therefore to place scale models of selected urban geometries in an environmental wind tunnel to simulate pollutant dispersion from city traffic. Pollutant dispersion in the wind tunnel is then determined by measuring concentration profiles of krypton-85 released from various source configurations. According to wind tunnel simulations, atmospheric lead and carbon monoxide concentrations should be higher on the upwind side of the source street under moderate crosswind conditions. This effect was confirmed by field measurements in downtown Fort Collins (population approximately 50,000) where air-lead values exceeding 10 ug/m^3 2 meters above the sidewalk are not uncommon under these conditions. The measurements suggest that air-lead levels along busy streets in smaller towns may not be greatly different than those in street canyons in major cities, notwithstanding the large difference in total city traffic volume. Additional studies involving cloud chamber tests indicate that lead is of minor importance in the ice nucleation properties of automobile exhaust.

Lead levels of soil, selected plants, and mice were also measured along Interstate 25 in Colorado in conjunction with the atmospheric sampling. Soil-lead levels become indistinguishable from background beyond about 100 meters downwind from the roadway edge. Up to several thousand ppm, lead taken up by roadside soil is only very slowly mobilized by water leaching and is not transferred to any major extent to growing plants tested thus far. Tests simulating atmospheric exposure of plants to particulate lead indicate that leaf and fruit cuticles are effective barriers to foliar uptake of atmospheric lead. Whole-body lead burdens of mice collected along the interstate are about three times higher than those for mice collected from a remote mountainous region of Colorado.

./.

Bacteria can take up substantial amounts of lead from lead-doped growth media without apparent effects on viability during the first growth cycle; prolonged exposure results in osmotically sensitive cells with decreased pigmentation. Electron micrographs and chemical analysis of cellular subfractions provide evidence for immobilization of virtually all of the lead in the cellular envelope.

A full evaluation of the environmental significance of these findings depends to some extent upon the results of certain follow-up studies which are still in progress. Nevertheless, it is now clear that the evaluation methodologies developed for lead are capable of providing considerable detail concerning the environmental flow of a trace constituent, especially for the atmospheric component of that flow. For example, short-term temporal and spatial variations in atmospheric lead concentrations can be measured as a function of meteorological and traffic conditions by the techniques developed. This kind of detailed information is highly important in the development of transport models for the environmental flow of lead and other pollutants. The techniques are also applicable to the problem of detecting meteorological, topographic, and structural factors which tend to inhibit dispersal of lead and other atmospheric pollutants in urban areas.

This research is supported by the National Science Foundation through the Research Applied to National Needs Program on Environmental Systems and Resources, Grant GI-34813X.

BENZINE ADDITIVATE MEDIANTE PIOMBO ISOTOPICAMENTE DIFFERENZIATO

*P. GARIBALDI, **S. FACCHETTI, ***A. QUAGLIARDI, ****G. VANINI,
*****P.P. GADDO, **M. DE BORTOLI, **P. GAGLIONE

* SNAM PROGETTI - Laboratori Ricerca Prodotti Petroliferi, Milano - Italia
*** Società Italiana Additivi per Carburanti S.p.A., Milano
** Centro Comune di Ricerca EURATOM, Ispra - Italia
**** Istituto di Igiene Università di Torino - Italia
***** FIAT S.p.A - Direzione Centrale Ricerca Laboratori Centrali, Torino - Italia

RIASSUNTO - La tecnica della determinazione della composizione isotopica del piombo opportunamente impiegata, è ritenuta capace di definire l'incidenza del traffico automobilistico sull'inquinamento da piombo dell'ambiente, in particolare aria, suolo, vegetazione, cibo e del corpo umano.

Si prevede l'impiego in almeno due regioni italiane, di benzine additivate con piombo di composizione isotopica costante e differenziata rispetto al piombo presente sia naturale che di altra provenienza.

Analisi effettuate su campioni di piombo estratto dalle principali miniere hanno mostrato che il piombo australiano (miniera di Broken Hill) ha una composizione isotopica nettamente diversa.

Con tale piombo saranno pertanto preparati gli additivi anti-detonanti da impiegare nelle benzine poste in commercio nelle regioni in esame.

Una campionatura adeguata dovrebbe permettere di determinare il contributo all'inquinamento del piombo di origine automobilistica.

Determinazioni analitiche relative ad altri metalli eventualmente presenti nell'atmosfera daranno informazioni utili al problema più generale del particolato atmosferico.

Le zone prescelte per la ricerca sono il Piemonte (città di Torino e provincia) e la Sardegna (città di Cagliari e provincia); il primo per la elevata intensità di traffico e l'alto livello industriale, la seconda in quanto isolata e per il contenuto in piombo del suolo che può influenzare la dieta. Ambedue le regioni presentano una situazione favorevole per l'approvvigionamento con la benzina del tipo voluto.

La durata dell'esperienza è prevista in 3 anni a partire dalla primavera del 1974. Le benzine additivate con piombo australiano saranno distirbuite sul mercato per un periodo di 18 mesi.

INCORPORATING ADDITIVES OF ISOTOPICALLY DIFFERING LEAD IN PETROL

*P. GARIBALDI, **S. FACCHETTI, ***A. QUAGLIARDI, ****G. VANINI,
*****P.P. GADDO, **M. DE BORTOLI, **P. GAGLIONE

* SNAM PROGETTI - Laboratori Ricerca Prodotti Petroliferi, Milano - Italy
*** Società Italiana Additivi per Carburanti S.p.A., Milano
** Centro Comune di Ricerca EURATOM - Ispra - Italy
**** Istituto di Igiene Università di Torino - Italy
***** FIAT S.p.A - Direzione Centrale Ricerca Laboratori Centrali, Torino - Italy

ABSTRACT - When correctly applied the technique used to determine the isotopic composition of lead can be used to monitor the contribution of road traffic to lead pollution in the environment, especially in the atmosphere and in soil, vegetation, food and the human body.

Tests will be carried out in at least two regions of Italy, using petrols containing lead with an isotopic structure which is either identical to or different from that of the lead they currently contain (whether naturally or from some other source).

Analyses of lead samples from major mines have shown that Australian lead (Broken Hill Mine) has a markedly different isotopic composition.

We intend to use this type of lead to prepare anti-knock additives for use in petrols to be marketed in the regions under study. Appropriate sampling should then enable us to determine how far lead pollution is due to exhaust emissions from cars.

Analytical tests on the possible presence of other metals in the atmosphere will provide useful information on the more general problem of atmospheric particulates. The areas selected for this study are Piedmont (Turin and district) and Sardinia (Cagliari City and district); the first was chosen for its high traffic density and high level of industrialization, and the second because it is exceptional in having a high lead content in the soil, which could influence diet. Both these regions are well suited to market distribution of the required type of petrol.

The programme of tests is scheduled to last for three years beginning in spring 1974. Petrols containing additives of Australian lead will be distributed on the market for a period of 18 months.

INTERCOMPARISON PROGRAMME ON THE ANALYSIS OF LEAD, CADMIUM AND MERCURY IN BIOLOGICAL FLUIDS

*A. BERLIN, **J.P. BUCHET, **P. DEL CASTILHO, **R. LAUWERYS, **H. ROELS,
*J. SMEETS

*Health Protection Directorate, Commission of the European Communities,
Luxembourg, Grand Duchy of Luxembourg
**Ecole de Santé Publique, Université de Louvain, Bruxelles, Belgium

---

ABSTRACT - As a follow-up to the 1972 First European Intercomparison Programme on the Analysis of Lead in Blood in which about 30 laboratories participated (the rather poor results which were obtained could not be satisfactorily explained), a Second Intercomparison Programme has been undertaken covering cadmium, lead and mercury in both blood and urine.

The continuing interest in lead, the increasing interest in cadmium and mercury as environmental pollutants, and the growing use of body burden determinations for the assessment of exposure, make it imperative to have reliable methods of analysis giving comparable results.

The awareness of the laboratories of this need is demonstrated by the participation of close to 80 laboratories in this programme.

The results will be discussed in terms of the techniques used and of the experience of the laboratories. Case has been taken in the design of the study to test the intra and inter laboratory variability.

A COMPARISON OF METHODS FOR ANALYSIS OF CADMIUM IN FOOD AND BIOLOGICAL MATERIAL.

A COOPERATIVE STUDY BETWEEN SWEDEN, JAPAN AND USA.

*TORD KJELLSTROEM, BIRGER LIND
**KENZABURO TSUCHIYA
***EDYTHALENA TOMPKINS

*Department of Environmental Hygiene, Karolinska Institute, Sweden
**Department of Preventive Medicine and Public Health,
Keio University, Japan
***Division of Health Effects Research,
US Environmental Protection Agency, USA

ABSTRACT - Dependable chemical analytical methods are of utmost importance in studies on health effects of environmental pollutants. The metal cadmium has received much attention because of severe health effects among cadmium exposed workers and women in a polluted area of Japan. Urinary cadmium is an indicator of both body burden and cadmium-induced kidney damage. Cadmium concentration in rice and wheat is used to evaluate the exposure. In this study the accuracy of cadmium analysis in urine, rice and wheat has been studied by comparing analysis performed with two principally different methods and in three countries, Sweden, Japan and the United States.

For urine, atomic absorption after extraction in organic solvent was used for analysis in all three countries. The analytical technique was slightly different though and in Sweden two modifications of the methods were used. These analyses were compared with neutron activation analysis of cadmium performed in both Sweden and Japan. The urine material used was pool samples from Swedish laboratory personnel and cadmium workers. An addition standard was included to evaluate recovery and the total of ten samples were coded in such a way that the analysis was completely blind. The results will be ready in February 1974.

The wheat and rice samples were analyzed by atomic absorption. In Sweden the heated graphide atomizer was used and in Japan and USA a combination of extraction technique and regular flame analysis was performed. Neutron activation analysis was performed in the same way as for urine. Five Swedish wheat samples with expected cadmium concentrations down to 5 ng/g and five Japanese rice samples with expective cadmium concentrations between 200 and 1000 ng/g were used. The coding ensured a completely blind analysis. The results will be ready in February 1974.

THE DETERMINATION OF LEAD AND CADMIUM IN BLOOD BY ATOMIC ABSORPTION SPECTROSCOPY

H.T. DELVES

Institute of Child Health, 30 Guilford Street, London WC1, UK

ABSTRACT - The determination of lead and cadmium in blood is often carried out as part of environmental surveys for evidence of increased absorption of these metals and it is desirable particularly if young children are involved, to use small sample volumes.

Atomic absorption methods for the determination of lead in microlitre volumes of blood require the use of highly efficient atomization systems such as discrete sampling flame atomizers, and flameless atomization systems. Both types of system have been used in the author's laboratory for bloodlead analysis. The sensitivities of the methods are 1×10^{-10}g and 2.6×10^{-11}g (for one percent absorption at 283.3nm) and the volumes of blood required for the analysis are 10 µl and 2 µl for the flame and flameless techniques respectively.

Procedures will be discussed for overcoming the non-specific absorption interferences which occur for both methods and which can give erroneously high results unless eliminated.

The accuracy, precision, analysis rate, and ease of application of these methods to routine analysis of large numbers of samples will be compared and discussed.

The determination of cadmium in blood may be determined in 0.5 to 1.0 ml samples of blood by solvent extraction and atomic absorption by using conventional nebulizer-burner atomization systems. However, due to the variations in reagent blanks and the limited sensitivity, the lower limiting concentration that may be determined is approximately 0.2 µg/100 ml. By using either of the two alternative atomization systems mentioned above, cadmium can be determined in blood with only micro-litre volumes. The atomic absorption determination of cadmium in blood by these three atomization techniques will be discussed.

MESURE DU PLOMB DANS DES OS HUMAINS PROVENANT DE LA REGION PARISIENNE

L. JEANMAIRE, F. PATTI, N. CIALELLA, R. GROS

C.E.A. - Service de Recherches Toxicologiques & Ecologiques
Fontenay-aux-Roses, France.

RESUME - Cette étude a pour but l'obtention de données systématiques sur la teneur en plomb des os de personnes habitant la région parisienne. Les prélèvements sont faits pour obtenir des informations sur deux types d'os (côtes et vertèbres), sur les diverses classes d'âges et sur les deux sexes. Après minéralisation de l'os et concentration chimique le plomb est dosé par fluorescence X. Les résultats présentés correspondent à une centaine d'échantillons. On note généralement une concentration plus forte dans les vertèbres que dans les côtes et une augmentation en fonction de l'âge. Il est possible que les concentrations soient plus faibles chez les femmes que chez les hommes, mais l'échantillonnage actuel ne permet pas de l'affirmer. Ce travail n'est qu'une étape intermédiaire et doit être complété par de nouvelles mesures pour être réellement significatif de la contamination du plomb de la population parisienne.

ZUR BLEI- UND CADMIUMANALYTIK IN BIOLOGISCHEN MATRICES

F. BACKHAUS, *M. DUMONT, H. HAGEDORN-GOETZ, K. HILPERT, H.W. NUERNBERG,
M. STOEPFLER, P. VALENTA

Zentralinstitut für Analytische Chemie der Kernforschungsanlage Jülich
(KFA), Bundesrepublik Deutschland
*Ecole des hautes études industrielles, Lille, France

KURZFASSUNG - Die Beurteilung von Schadstoffeinflüssen auf den menschlichen Organismus muss sowohl auf medizinischen Befunden wie auf den Ergebnissen quantitativer chemischer Analysen beruhen.

Aus vergleichenden Untersuchungen zur Richtigkeit von Spurenanalysen ist jedoch bekannt, dass häufig relativ grosse Schwankungsbreiten der Analysenwerte für ein gegebenes Element in identischer Matrix auftreten. Daher ist die Frage der Richtigkeit (accuracy) stets von besonderer Bedeutung.

Man kann dieses Problem im allgemeinen nur dann mit hinreichender Sicherheit lösen, wenn man die Ergebnisse verschiedener Aufschluss- und / oder Bestimmungsmethoden für das gesuchte Element in standardisierter Matrix miteinander vergleicht. Neben einem möglichst exakten Ergebnis wird bei derartigen Vergleichen auch die Eichung "relativer" durch "absolute" Verfahren angestrebt.

Wir haben unter diesen Gesichtspunkten für die Matrices Blut, Urin, Haare und Gewebe Aufschluss- und Bestimmungsverfahren für Blei und Cadmium untersucht.

Bei den Aufschlussmethoden wurde die konventionelle Trockenveraschung, die Mikrowellenveraschung in einem Sauerstoffplasma sowie einige Varianten der Nassveraschung im offenen und geschlossenen System studiert. Ausbeuten wurden dabei mit Radiotracern überprüft.

Zur Elementbestimmung wurde ein Zweikanal-Atomabsorptionsspektrometer mit angeschlossener Graphitküvette zur flammenlosen Atomisierung, die Pulse-Polarographie mit und ohne anodic stripping, sowie anlaufend die Isotopenverdünnungsmassenspektrometrie eingesetzt. Die beschriebenen Verfahren erreichen dabei Nachweisgrenzen ≤ 1 ppb.

Basierend auf diesen Untersuchungen werden die Zuverlässigkeit, die erreichbare Analysenfrequenz und die effektiven Kosten verschiedener Analysenmethoden und dadurch mögliche optimale Kombinationen - die je nach Matrixtyp verschieden sein können - diskutiert. Abschliessend werden die Ergebnisse einer Reihe routinemässiger Pb- und Cd-Analysen in diversen Proben - die teilweise auch von anderen Laboratorien zum Vergleich analysiert wurden - mitgeteilt.

THE ANALYSIS OF LEAD AND CADMIUM IN BIOLOGICAL MATRICES

F. BACKHAUS, *M. DUMONT, H. HAGEDORN-GOETZ, K. HILPERT, H.W. NUERNBERG,
M. STOEPPLER, P. VALENTA

Central Institute for Analytical Chemistry at the Nuclear Research Station
Jülich (KFA), Federal Republic of Germany
*Ecole des hautes études industrielles, Lille, France

ABSTRACT - The assessment of the influence of noxious substances on the human system must be based on both medical diagnoses and the results of quantitative chemical analyses.

It has, however, been established by comparative investigations into the accuracy of trace analyses that relatively wide analysis-value scatter bands for a given element in an identical matrix frequently occur. For this reason, the question of accuracy is always especially important.

Generally, this problem can only be solved with a satisfactory degree of certainty if the results of various decomposition and/or determination methods for the element sought are compared with each other in a standardized matrix. Apart from the most accurate possible result, efforts are made, in such comparisons, to calibrate "relative" processes, thus obtaining "absolute" ones.

With these aspects in mind, we have investigated decomposition and determination processes for lead and cadmium in the matrices of blood, urine, hair and tissue.

The following decomposition methods were studied: conventional dry incineration, micro-wave incineration in an oxygen plasma and several variations of wet incineration in open and closed systems. Yields were examined with ratio tracers.

A two-channel atom absorption spectrometer linked with a graphite tray for flameless atomization, pulse polarography with and without anodic stripping and, at the beginning, isotope dilution mass spectrometry were employed to determine elements. The processes described achieved detection limits of $\leqslant 1$ ppb.

On the basis of these investigations, the reliability, the analysis frequency obtained and the actual costs of various analysis methods - and thus possible optimum combinations - which, depending on the type of matrix, could differ, are discussed. Finally, the results of a series of routine Pb and Cd analyses with various samples, some of which were also analysed by other laboratories for the sake of comparison, are given.

HAIR AS AS DIAGNOSTIC INDICATOR OF HUMAN EXPOSURE TO TRACE ELEMENTS

ADON A. GORDUS

Department of Chemistry The University of Michigan
Ann Arbor, Michigan 48104 U.S.A.

ABSTRACT - Samples of human scalp hair from heterogeneous, selected homogeneous, and industrially exposed population groups are being analysed for up to 40 elements using a combination of instrumental neutron activation analysis (INAA) and flameless atomic absorption spectrometry (FAAS). Visual and microscopic examimation of the hair samples provides data on hair color and morphology. Personal data, including information on age, height, weight, shampoos used, food preferences, etc., provide a means of determining the degree to which the trace element content of hair is dependent on personal factors.

Following washing of about 20 mg. samples of hair, INAA provide data for Na, Mg, Al, S, Cl, K, Ca,Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zu, As, Se, Br, Rb, Sr, Ag, Sb, Te, I, Ba, La, Sr, Au, and Hg. The irradiated hair samples are then dissolved in HNO_3 and, using FAAS, data are obrained for Li, Be, Si, Ga, Mo, Cd, Sn, Cs, Tl, Pb, Bi, and, if mecessary, more reliable data for K, Ti, Fe, Ni, Cu, Zn, Rb, Sr, Ag, Sb, and Ba.

The majority of analyses performed thus far are for hair samples from selected homogeneous population groups and include University of Michigan students and young men at the U.S. Naval and Air Force Academies. Clippings from the midshipmen and cadets were obtained when they first arrived at the academies in summer, 1971, and again in Dec., 1971, May, 1972 and May, 1973. Extensive analyses, especially for the Naval Academy midshipmen hair samples, have been performed for Mg, Al, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Ag, Sb, I, and Hg. In almost all cases a decrease in variance (and occasionally a marked shift in the mean value) is found for the more recent hair clippings, presumably a result of equilibration due to the common environment and diet. Other factors are also especially evident: the use of selenium or zinc-containing shampoos results in higher measured hair contents for these elements; the frequency of hair washing correlates negatively with the iodine and chlorine contents; some of the levels of trace-elements in hair appear to correlate with the level of scholastic performance; gross differences in diet is evidenced, for example, by comparing the hair content of midshipmen and Alaskan Eskimos. Numerous other observations and correlations will also be presented.

THE CONCENTRATIONS OF COPPER, IRON, MANGANESE, ZINC AND CADMIUM IN HUMAN HAIR AS A POSSIBLE INDICATOR OF THEIR TISSUE CONCENTRATIONS

E. VUORI
The Department of Public Health Science,
University of Helsinki, Helsinki, Finland
A. HUUNAN-SEPPÄLÄ
The Department of Public Health Science,
University of Helsinki, Helsinki, Finland
J.O. KILPIÖ
The Department of Public Health Science,
University of Helsinki, Helsinki, Finland

Summary

Samples from lung, muscle, liver, kidney and hair were collected from 20 accidentally died persons. The tissue concentrations of copper, iron, manganese, zinc and cadmium were determinated by atomic absorptions spectrophotometry using both flame- and flameless atomizing system. Linear coefficient of correlation was calculated between different tissues for each element measured.

The amounts of the trace elements measured in tissues in the present study were approximately the same order as those reported in litterature for Finnish population. However, in our material the values of copper in tissues were about two times higher than those reported earlier.

In the present study no significant correlation between the concentrations of trace elements in hair and other tissues was found except between the zinc contents of hair and muscle. It seems to us that the concentrations of trace elements in human hair hardly can be used as an indicator of their concentrations in other tissues as far as the trace elements included in this study are concerned and the concentrations of these trace elements fall into a "normal" range.

TRACE ELEMENTS IN LUNG AND HAIR

GRAHAM WILLIAM GIBBS, EMILIJA BOGDANOVIC

Department of Epidemiology and Health, McGill University
Montreal, Quebec, Canada

ABSTRACT - In order to determine the health effects of airborne inorganic particulates on man, it is first necessary to establish reliable methods of measuring exposure. Total lung burden might be a useful index, but there is little information on its relationship to measured concentrations of airborne particulates and rates of removal of air pollutants from the lung. Studies to clarify these relationships and associations between the concentrations of trace elements in lung and diseases in man are often hampered by the difficulty of obtaining whole lungs for analysis. An alternative method is to use a portion of lung, but this requires a knowledge of the distribution of particulates within it. Hair, which can be readily obtained might be useful but how its trace element content relates to exposure requires investigation.

This report will describe the distribution of trace elements and total inorganic particulates within the lung and their relationships if any to the concentrations of the same elements in hair. Whole lungs, lymph nodes, head and pubic hair have been collected at routine autopsy from 20 urban and 20 rural dwellers. For each case a residential history has been obtained. Each lung has been dissected into broncho pulmonary segments (left lung - 8 segments, right lung - 10 segments and each segment ashed at 450°C. A semi-quantitative analysis of ash using X-ray fluorescence techniques indicated the presence of K, Na, P, Si, (2-50%); Fe, Ca, Mg, (0.5-5%); Al, B, Ti, Zn, (0,01-0.1%); Cr, Cu, Mn, Zr, Ba, Ni, Pb, V, Sn, Sr, (0,001-0.05%). Each lung segment and hair sample is being analysed quantitatively for the same elements using atomic absorption spectrophotometry.

Preliminary results for rural dwellers indicate slightly higher contents of ash from the upper lobes compared with the other lobes with the overall concentration of ash in dry lung ranging 3.9 to 7.7 per cent. The total lung burden and trace element concentrations in lungs of urban dwellers will be compared with the results for rural dwellers. The distribution of trace metals within lung and the relationships between trace elements in whole lung and hair will be described.

TRACE METAL CONTENT IN HAIR AND THE LEVELS OF 5-HIAA IN THE URINE OF POPULATION EXPOSED TO LEAD

B. Stanković, M. Stanković, S. Milić, Z. Korećanac, Lj. Milovanović
M. Dugandžić

Institute of Occupational and Radiological Health, Belgrade
and
Institute of Inorganic and Analytical Chemistry, Faculty of Pharmacy, Belgrade, Yugoslavia

---

ABSTRACT - The exposure of workers to a mixture of heavy metals is quite common but poorly studied. Such exposures are found as a rule in smelting and refining plants of non-ferrous metals.

Recently attention is paid to the determination of various trace metals in the hair as a biotoxicological index of a prolonged exposure, and to assess the metabolic status of individuals and groups living or working environment.

Our aim was to compare the content of some toxic (lead, cadmium) and essential metals(zinc, copper) in several selected groups:

1/ a group of peasants far from any pollution
2/ a group of inhabitants of Belgrade
3/ a group of workers from a lead-zinc smelting plant
4/ a group of inhabitants of the area around a lead-zinc smelting plant

The results of lead, cadmium, zinc and copper determination in the hair of these groups(population, workers) are evaluated and discussed.

Epidemiological data also suggested that, in the inhabitants living in the vicinity of a lead smelting plant, lead can be accumulated as a result of increasing environmental contamination. The concentration of lead in air of environment of that area has varied from 1 to 80 $\mu g/m^3$. With regard to the fact that lead exposure could induce more subtle derangements in the metabolism of some amino acids, we studied the urinary excretion of 5-HIAA.

A group of 120 inhabitants of different ages, living near lead plant was under investigation. As the control a group of 30 citizens without known lead exposure has been examined. A study of the excretion of 5-hydroxyindolacetic acid (5-HIAA) parallel to the delta-aminolevulinic acid (ALA) excretion in the urine was carried out. Some results of our investigations are shown in the table.

./.

BIOLOGICAL PARAMETERS	EXPOSED GROUP		CONTROL GROUP	
	MEAN	STAND.DEV.	MEAN	STAND.DEV.
5-HIAA, mg/lit	7.35	2.32	2.86	1.21
d-ALA, mg/lit	9.20	8.65	5.21	2.48

The increased levels of 5-HIAA in the exposed population were evident. The difference between arithmetic means of 5-HIAA in the urine of exposed and not exposed population was statistically significant. This study demonstrated that 5-HIAA excretion in the inhabitants near lead smelting plant represents a consequence of actual lead exposure. Our results are suggesting that 5-HIAA excretion can be used as an additional (to other biological parameters) biochemical test for the assessment of the environmental lead exposure.

EVALUATION EN MICROSCOPIE OPTIQUE DU DEGRE DE L'EMPOUSSIERAGE PULMONAIRE ASBESTOSIQUE PAR MICROFILTRATION DE L'EXPECTORATION ET DU SUC GASTRIQUE

J. BIGNON*, B. HEM*, G. BONNAUD**, P. SEBASTIEN**, G. MONCHAUX**

*Hôpital Laënnec, Université Paris V - 75007
**Direction de l'Action Sanitaire et Sociale - 75013 Paris France

RESUME - L'identification et le dénombrement des corps ferrugineux (asbestosiques) et des fibres d'asbeste ont été réalisés dans l'expectoration et dans les sécrétions gastriques prélevées par tubage gastrique à jeun. La méthodologie utilisée est la suivante: après digestion de la matière organique, les résidus solides sont recueillis par microfiltration sur membrane millipore. L'examen de la totalité du filtre au microscope optique permet le comptage des corps asbestosiques et des fibres dans la totalité de l'échantillon.

Cette méthode a été utilisée à la fois pour la numération et l'identification des corps ferrugineux et des fibres nues recueillis dans l'expectoration, le suc gastrique et des fragments de tissu pulmonaire. La numération des corps ferrugineux a révélé qu'il existait une corrélation étroite entre le nombre de corps ferrugineux trouvés dans l'expectoration et le nombre de ces mêmes corps trouvés dans le poumon. Il semble qu'au-dessus de la concentration intra-parenchymateuse de 1 000 corps ferrugineux par cm3 de poumon, on retrouve les corps ferrugineux dans l'expectoration.

Pour certaines observations, ont été comparés les résultats obtenus par examens de l'expectoration, de suc gastrique et des fragments de tissu pulmonaire. En outre, la microfiltration de l'expectoration ou des sécrétions gastriques permet de prélever des fibres ou des microfibrilles pour l'étude au microscope optique ou au microscope électronique, avec possibilité d'une identification précise de la nature des fibres, soit par la mesure de l'indice de réfraction, soit par la micro-diffraction électronique, couplée à la micro-anlyse X au microscope électronique à balayage.

La microfiltration constitue une méthodologie simple et très reproductible qui peut facilement être exploitée en routine:

- soit dans un but diagnostique pour confirmer l'origine asbestosique professionnelle d'une affection thoracique (fibrose pulmonaire, pleurésie, pachypleurite ou calcifications pleurales, tumeur maligne de la plèvre et cancer broncho-pulmonaire) ou même extra-thoracique (mésothéliome péritonéae, cancer digestif).

- soit pour permettre un dépistage par évaluation du degré d'empoussiérage pulmonaire asbestosique chez les sujets professionnellement exposés.

Néanmoins, il semble exister des divergeances entre les résultats obtenus par microfiltration et les résultats obtenus par des méthodes utilisant la centrifugation. Ces divergeances sont particulièrement sensibles au niveau du dénombrement des fibres nues. Ce point de méthodologie est très important et doit être discuté entre les divers laboratoires qui travaillent ce sujet; en effet, il apparait que le rapport entre le nombre de fibres nues et le nombre de corps ferrugineux constitue un paramètre très intéressant.

EVALUATION OF THE LEVEL OF ASBESTOS DUST IN THE LUNGS BY MICROFILTRATION OF THE EXPECTORATION AND GASTRIC JUICE

J. BIGNON*, B. HEM*, G. BONNAUD**, P. SEBASTIEN**, G. MONCHAUX**

* Hôpital Laënnec, Université Paris V - 75007
** Direction de l'Action Sanitaire et Sociale - 75013 PARIS, France

---

ABSTRACT The ferruginous (asbestos) bodies and asbestos fibres present in the expectoration and gastric secretions (samples taken by gastric tube from an empty stomach) were identified and counted as follows: after digestion of organic matter, the solid residues were collected by microfiltration over a milipore membrane. The whole of the filtered material was examined by optical microscope so that the number of asbestos bodies and fibres in the total sample could be counted.

This same method was used to count and identify the ferruginous bodies and naked fibres collected in the expectoration, gastric juice and fragments of pulmonary tissue. A calculation of the number of ferruginous bodies revealed a close correlation between the number found in the expectoration and the number found in the lung. It appears that in addition to the inter-parenchymatous concentration of 1,000 ferruginous bodies per cm^3 of lung, ferruginous bodies are found in the expectoration.

In certain cases, the results obtained by examination of the expectoration, the gastric juice and fragments of pulmonary tissue were compared. In addition, microfiltration of the expectoration or the gastric secretions made it possible to study fibres or microfibrils under the optical or electron microscope, and thus to identify accurately the nature of the fibres, either by measuring the refractive index, or by electron micro-diffraction, coupled with microscale x-ray analysis with a scanning electron microscope.

Microfiltration is a simple and easily reproducible method which can be used as a matter of routine to:

- confirm, when making a diagnosis, that the source of a thoracic disease (pulmonary fibrosis, pleurisy, pachypleuritis or pleural calcifications, malignant tumour of the pleura and broncho-pulmonary cancer) or even extra-thoracic (peritoneal mesothelioma, cancer of the digestive system) is asbestos to which the subject has been exposed at work.
- to provide an evaluation of the level of asbestos dust in the lungs of subjects exposed during the course of their work.

However, it appears that there are differences between the results obtained by microfiltration and those obtained by centrifugation methods. These differences are especially noticeable in the numbers of naked fibres counted. This question of method is very important and should be discussed by the various laboratories working on this subject. It appears, in fact, that the ratio of naked fibres to ferruginous bodies constitutes a very important parameter.

EVALUATION QUANTITATIVE DE L'EMPOUSSIERAGE PAR L'AMIANTE PULMONAIRE ET PLEURALE PAR MICROSCOPIE OPTIQUE ET MICROSCOPIE ELECTRONIQUE

A. FONDIMARE, J. DESBORDES, J. TAYOT, J. PERROTEY

Laboratoire d'Anatomie pathologique,
Centre Hospitalier du Havre, Le Havre, France

RESUME - Les auteurs ont étudié 15 malades soumis à un empoussiérage par l'amiante de type professionnel, et le comparent à quelques sujets chez lesquels l'on a découvert des corps asbestosiques ou ferrugineux sans notion d'exposition professionnelle importante.

Le matériel étudié comporte des expectorations, des pièces de pneumonectomie et enfin du matériel autopsique.

Dans tous les cas, les lésions anatomiques, plaque pleurale, mésothéliome éventuel, fibrose pulmonaire ou cancer broncho-pulmonaire, sont étudiés. Les corps asbestosiques ou ferrugineux sont recherchés sur coupes histologiques par microscopie optique.

Les données anatomo-cliniques étant ainsi confrontées à la notion de risque professionnel, l'amiante est recherchée et une étude quantitative est tentée par les moyens suivants:

Une masse de référence de 4 gr de tissu pleural ou pulmonaire est détruite par la potasse à 40%. L'on obtient ainsi une suspension qui est centrifugée et lavée trois fois. Une partie de cette suspension (représentant 20 ml) est étudiée en microscopie électronique, le reste du produit est filtré sur membrane Millipore.

Ces techniques permettent la numération des corps asbestosiques ou ferrugineux par unité de poids, l'identification des particules par diffraction électronique, et enfin un essai de numération des fibres nues visibles en microscopie électronique.

Les résultats obtenus montrent chez les sujets à haut risque professionnel un empoussiérage de l'ordre de:

10^4 à 10^5 corps asbestosique pour 4 gr de poumon.

Selon notre estimation le nombre de fibres nues dans le même échantillon en microscopie électronique varierait de:

10^6 à 10^7

./.

Les variétés d'amiante retrouvées dans les poumons correspondent à plus de 99% à des amphiboles. Les sujets présentant ce type d'empoussiérage ont des lésions de fibrose, de cancer broncho-pulmonaire ou de mésothéliome. Les mêmes méthodes ont permis de constater la présence d'amiante dans les poumons ou la plèvre (plaques pleurales) de sujets peu ou modérément exposés. Les chiffres obtenus sont en général très inférieurs avec, en particulier au niveau de la plèvre des phénomènes de concentration locale, il nous a été donné d'observer quelques mésothéliomes chez des sujets présentant ce type quantitatif d'empoussiérage.

QUANTITATIVE EVALUATION OF ASBESTOS DUST LEVELS IN LUNGS AND PLEURA BY OPTICAL AND ELECTRON MICROSCOPY

A. FONDIMARE, J. DESBORDES, J. TAYOT, J. PERROTEY

Hospital Centre, Le Havre, France
Rouen University Hospital Centre
Teaching and Research Unit for Science and Technology, Le Havre

---

ABSTRACT - The authors studied 15 patients who had been exposed to asbestos dust during the course of their work, and compared them with subjects in whom asbestos or ferruginous bodies had been discovered, without significant occupational exposure.

The material studied included expectorations, pneumonectomy samples and autopsy material.

In all cases, the anatomical lesions, pleural plaque, mesothelioma (if present), pulmonary fibrosis or broncho-pulmonary cancer, were studied. Histological sections were used to study the asbestos or ferruginous bodies by means of optical microscopy.

The anatomical-clinical data thus obtained being considered from the point of view of occupational risk, research was then carried out on asbestos and a quantitative study was attempted by the following methods:

A reference sample of 4 gr of pleural or pulmonary tissue was put into suspension with 40% potassium carbonate. The suspension was then centrifuged and washed three times. Part of this suspension (20 ml) was studied by electron microscope, and the rest of the product filtered over a millipore membrane.

Using these techniques, it was possible to count the asbestos or ferruginous bodies in weight units, identify particles by electron diffraction and finally attempt to count the naked fibres revealed by the electron microscope.

The results obtained showed that in subjects exposed to a high occupational risk, there was a dust level of the order of:

10^4 to 10^5 asbestos bodies per 4 gr of lung.

./.

According to our assessment, the number of naked fibres in the same sample, revealed by electron microscopy, would range from:

10^6 to 10^7.

In more than 99% of cases, the types of asbestos found in the lungs were amphiboles. Subjects with dust levels of this kind showed fibrosis, broncho-pulmonary or mesothelioma lesions. The same methods were used to detect the presence of asbestos in the lungs or the pleury (plural plaques) in subjects only slightly or moderately exposed. The figures obtained were in general very much lower, with, in the pleura especially, local concentrations. Some mesotheliomas were observed in subjects with dust levels of this order in the lungs.

DETERMINATION OF CADMIUM IN BLOOD USING A 4.00 MM PAPER DISC - GRAPHITE FURNACE TECHNIQUE. APPLICATION TO INDUSTRY

A.A. CERNIK, M.H.P. SAYERS

Employment Medical Advisory Service, Department of Employment
London, W.2., UK

ABSTRACT - The application of atomic absorption spectrophotometry to micro biological samples by Delves (1970) was a great advance in the estimation of blood lead. The modification of this technique to overcome difficulties of pipetting microlitre samples by using a punched paper disc technique (Cernik and Sayers, 1971) further facilitated this analysis, but precluded its application to other metals such as cadmium, which have relatively lower vapour pressures. This prevents resolution of the specific signal from that due to the combustion of the paper and blood.

The flameless method has been shown to have many advantages over the flame, and the use of a micro carbon cup has proved of value in the determination of lead in blood, using a 4.0 mm punched disc (Cernik, 1973). The small sample size and the ease of preparation, coupled with the low detection limits and high precision, combine to render this perhaps the simplest method we know for blood lead estimation today.

Carbon cup analysis using atomic absorption spectrophotometry can resolve the matrix interference by precise control during the ashing stage, enabling the punched disc technique to be used for the determination of cadmium. The efficiency of the initial ash to remove the paper and blood, but not the cadmium, is established by use of the H_2 lamp before the analysis proper starts. A temperature that is sufficient to ash the matrix but not vapourise the cadmium is achieved and results in precise replicate cadmium peaks when the metal is subsequently measured.

The very fast volatilisation rate of cadmium gives rise to problems with the amplifier response and the recording of the transient peak signal, which are discussed. Control at the volatilisation stage is important, otherwise curvature of the calibration graph will result.

Using a 4.0 mm paper disc, absorbance was found to be linear to concentration over the range 0-10 μg Cd/100 ml blood. At the level of 106 picograms (corresponding to 5.3 μg Cd/100 ml blood) the standard deviation was 0.32 μg (R.S.D. 6%). The absolute sensitivity for 1% absorbance was 4×10^{-12} g. Quantities of cadmium in the blood of adults not exposed to known cadmium risks have been determined and compared with those found in cadmium workers.

PROPERTIES OF CARRIER-BOUND CHOLINESTERASES: A POSSIBLE TOOL FOR THE DETERMINATION OF LOW CONCENTRATIONS OF ORGANOPHOSPHORUS COMPOUNDS

C. ALSEN F.K. OHNESORGE

Institut f. Pharmakologie Christian-Albrechts-Universitat, Kiel, BRD

ABSTRACT - The detection of very low concentrations of highly reactive organophosphates in water (and air) is usually difficult because of their rapid hydrolytic degradation. Therefore, it is important to determine organophosphates in loco. This determination by means of cholinesterase inhibition, however, raises some problems, since the available cholinesterase-preparations are unstable and water-soluble. Both difficulties can be overcome by the covalent coupling of specific or non-specific cholinesterases to an unsoluble copolymerisate of butandioldivinylether and maleinic anhydride. The coupling process can be easily performed and yields a very stable product of high cholinesterase activity. Different batches of the carrier-bound acetylcholinesterase show identical properties with respect to enzyme kinetic parameters (pH-optimum 8-8,5; substrate-optimum 3×10^{-3} Acetylcholin; k_m-value = 1.9×10^{-4} ACh), which do not differ significantly from the uncoupled enzyme. The coupled cholinesterase is, however, much more stable with respect to changes of the pH, the ionic strength, the temperature and can be stored in 0.9 % saline for more than 20 weeks without loss of activity. For practical purposes, the bimolecular rate constants of a series of organophosphorus inhibitors were determined at different incubation temperatures (10-20°C). At a given incubation time measurement of the inhibition of the carrier-bound cholinesterases enables the estimation of the concentration of organophosphates, expressed as paraoxone-equivalents. Certain organophosphates can be differentiated by the use of carrier-bound specific or non-specific cholinesterase.

THE INCIDENCE OF ELEVATED BLOOD LEAD VALUES IN AN ASYMPTOMATIC PEDIATRIC POPULATION RESIDING IN A MAJOR AMERICAN INDUSTRIAL STATE

P.R. FINE and D.D. DOBIN

Master Health Services, Chicago, Illinois

ABSTRACT - In the nation's first state-wide investigation and survey for lead poisoning in an asymptomatic population, blood specimens were obtained from more than 7,700 children between 1 and 6 years of age who resided in 20 Illinois cities of intermediate size (10,000 to 150,000)

During the first screening phase 6,151 children were sampled; 1,147 (18.6%) were found to have evidence of undue absorption of lead (greater than or equal to 40µg/100ml) while in 51 (0.8%) of the children unequivocal instances of lead poisoning occurred (greater than or equal to 80µg/100ml), according to the guidelines of the Surgeon General of the United States of America.

The percentage of children evidencing undue absorption of lead in each city varied from 9.6% to 31.3%, while the main blood lead levels of the samples from the different cities varied from 19.8µg/100ml to 32.9µg/100ml.

Preliminary analysis of Phase Two Screening has revealed extremely interesting results. The percent of asymptomatic children screened who demonstrated blood lead values in excess of 40 mcg.% ranged from 5.5% in one location to 13.5% in another locale. These figures are lower than the range reported during the 1971 campaign (9.6% - 31.3%). Despite the apparent reduction in range values, it is still alarming to note the significant percentage of children, randomly screened, who demonstrated elevated blood lead levels.

Perhaps a more meaningful and certainly a more significant finding which was demonstrated during the second phase was the fact that while the raw numbers of children (and therefore the relative percentage) with blood lead values equal to or greater than 40 mcg.% was somewhat lower in 1972, the mean blood lead values remained remarkedly similar between the two years. The Phase One mean blood lead value for all children tested was determined to be 25.5 mcg.%. Preliminary examimation of the 1972 data indicates a mean blood lead value of 27.32 mcg.% (corrected to reduce influence of fluctuating sample size).

The finds suggest that pediatric lead intoxication is not confined to urban slums, but does occur with alarming frequency in smaller communities.

MERCURY IN THE PLACENTA AND FOETAL MEMBRANES AS AN INDICATION OF LOW MERCURY EXPOSURE

AXEL WANNAG and JULIE SKJAERAASEN

Institute of Occupational Health, Oslo, Norway

ABSTRACT - In order to evaluate the foetal load of mercury with exposure to elementary mercury, we have compared two groups of women and their babies at birth. One group consisted of dentists, dentist assistants and dental technicians. The control group were arbitrarily chosen from other women delivering at the same hospital.

There were no differences between the groups in mercury content of erythrocytes or plasma in mothers or babies. Amnionic fluid also contained the same amount of mercury in both groups.

The placenta, chorion-allantois membrane and the amnion membrane contained, however, significant more mercury in the exposed group than in the control group.

Thus the mercury content of placenta, the chorion-allantois membrane or the amnion membrane may give an indication of mercury level to the foetus even with exposure loads which do not alter the blood or plasma content of mercury in mothers or babies.

HEALTH EFFECT STUDIES - NOW AND IN THE FUTURE

LARS FRIBERG

The Department of Environmental Hygiene The Karolinska Institute and
The National Swedish Environment Protection Board Stockholm, Sweden

ABSTRACT - Health effects, ranging from slight annoyance reactions at the one extreme and death at the other, can be studied toxicologically and epidemiologically. Toxicological studies must elucidate what metabolites are formed by a given substance and what mechanisms of action it has in nature and in the body. The ultimate aim of such studies is to obtain a dose-response curve, which is often difficult. Much valuable epidemiological and toxicological data are lost to the researcher simply because industrial health officers do not use their resources for the collection and compilation of such data or, if they do, they must often keep the results confidential. The TLV values for industrial exposure must be reevaluated since they do not always protect the worker. Differences in prevalence of disease among countries both from environmental and industrial agents have not yet been satisfactorily accounted for. Epidemiological base registers should be initiated or, when they exist, expanded, for example through material collected from questionaires. Factors of self-selection must be given due regard when data on voluntary exposure to harmful agents. e.g. cigarettes, are to be interpreted. Studies on twins which are discordant as to the exposure to a certain agent may be fruitful in this respect. Vital statistics, cancer registries and hospital records should be given more entrance into epidemiological studies. A plea is made for more extensive training of epidemiologists and toxicologists.

THE CARCINOGENIC RISK FOR MAN OF ENVIRONMENTAL CHEMICALS

L. TOMATIS

International Agency for Research on Cancer, Lyon, France

Abstract

The hypothesis that environmental factors play an essential role in the aetiology of human cancer is receiving wide support and it has been repeatedly asserted that over 80% of human cancers are due to environmental factors.

Environmental factors may act directly on individuals exposed and may affect pregnant women and therefore reveal an effect on a subsequent generation.

A direct effect of environmental factors in producing cancer in man has been shown by: (1) the unequivocal evidence of the chemical origin of occupational cancer, as in the cases of urinary bladder tumours in workers exposed to aromatic amines, lung cancers in workers exposed to bis(chloromethyl)ether, etc; (2) the well-documented cases of iatrogenic cancers; (3) the positive correlation between cigarette smoking and lung cancer; (4) the different cancer incidences in urban and rural populations and the possible role of air pollution; and (5) the results of studies on migrants showing that for some cancers migrants acquire incidences similar to those of the host countries. Results obtained in experimental carcinogenesis are in keeping with a direct carcinogenic effect of chemicals.

The evidence that exposure of pregnant women to a carcinogen may result in an increased risk of cancer in the progeny has been provided by the reports on the incidences of vaginal cancer in daughters of women exposed to stilboestrol during pregnancy. The role of prenatal exposure in determining cancer risks in the progeny is fully documented in experimental carcinogenesis.

The possibilities of removing or preventing carcinogenic hazards to man in the environment will be discussed.

INTERACTIONS OF ENVIRONMENTAL CHEMICALS ENZYMATIC CHANGES AND THEIR POSSIBLE EFFECTS ON MAN'S HEALTH

HANS L. FALK

National Institute of Environmental Health Sciences
Research Triangle Park, N.C. U.S.A

ABSTRACT - The interactions to be considered here will have resulted in unexpected increases in adverse biological effects from a chemical due to exposure to another chemical or physical agent, happening at the same time or a few days before or after the other exposure. The importance of such interactions lies in the exaggerated or entirely different nature of the biological response which can mean unanticipated hazards to man's health or the environment.

Such toxicological aggravations have been observed for several environmental chemicals reaching man in air, water or food and most frequently through the use of drugs. In the laboratory studies on interactions have resulted in the induction of cancer, birth defects and other chronic diseases. It has been emphasised that frequently the conditions utilized in laboratory settings to study interactions are not likely to be encountered in the general environment of man, but that it is essential to gain an understanding of synergistic events that could occur to be able to avoid such situations. However it is incorrect to state that under all real life situations of exposure synergism will not be encountered.

For many of the observed interactions the pricise mechanism of action is not completely understood, but the most widely accepted mode of action involves interference with enzyme activity, induction of enzymes and to some extent inhibition of enzyme induction. Although the liver is frequently involved as the major target for such action other tissues or organs are also affected. Synergism may also involve other mechanisms such as intercompetition for sites on enzymes or plasma proteins or result from interference with normal organ function. However, even when the mechanisms of action are understood, it may not be possible to predict the results of such interactions at given dose levels or temporal settings or to extrapolate data observed on acute studies to chronic exposure situations.

Instead of attempting to be encyclopedic in the enumeration of interactions, it is hoped to present examples of each type whether understood or judged to be of immediate importance to man or the environment or not, in order to alert the listener to potential limits of toxicity evaluations of individual chemicals when occupational, cultural or iatrogenic exposures to other agents may coexist.

PERSPECTIVES IN THE ENVIRONMENTAL TOXICOLOGY OF TRACE METALS

KENZABURO TSUCHIYA

Keio University School of Medicine, Tokyo

ABSTRACT - The term "environmental toxicology" has come into use in recent years, since environmental pollutions of trace metals and their effects on human health have been recognized. Environmental toxicology differs from industrial toxicology in that, not only does the former often include the latter, but is concerned usually with exposure to trace metals in much smaller doses by larger numbers of the general population, including children, the aged, and the sick.

The use of epidemiological approaches is very important in order to detect the insidious health effects of trace metals on the general population. In light of the significance of these approaches, the following five aspects of environmental toxicology have been chosen for discussion in this paper, with references to a number of reports on each aspect available up to the present time. They are:

1. Dynamic pathways of trace metals in the ecological environment
2. Accumulation of trace elements in human beings
3. Dose-response relationship
4. Detoxication of trace metals
5. Evaluation of unspecific responses in individuals and in groups.

Recommendations for further studies which still need to be done concerning each of these aspects are also included.

ASSESSMENT OF THE INFLUENCES OF ENVIRONMENTAL POLLUTANTS ON CANCER AND OTHER CHRONIC DISEASES

S.S. EPSTEIN
Environmental Health Programs, Case Western Reserve University
Medical School
Cleveland, Ohio

Abstract

There is now little doubt that many chronic diseases, hitherto regarded as spontaneous, particularly cancer, are caused by environmental pollutants. This realization is heightened by the exponential increase in exposure of the general population to currently used and new synthetic chemicals -- and their degradation products in air, water, and soil -- which, in general, are inadequately characterized toxicologically and ecologically. These considerations apply with even greater emphasis to relatively uncontrolled occupational exposure to a wide range of known chemical carcinogens, in addition to thousands of other toxicologically uncharacterized or inadequately characterized synthetic chemicals.

Current toxicological techniques are relatively insensitive and limited in their ability to detect toxic agents, particularly carcinogens teratogens and mutagens, individually and in various combinations or mixtures realistically reflecting low or ambient levels and patterns of environmental exposure. Similarly, it is generally considered that epidemiological techniques are unlikely to detect environmental pollutants, such as weak carcinogens, unless there are sharp differentials in exposure of the general population, as with cigarette smoking. For widely dispersed agents to which the population-at-large is generally and ubiquitously exposed, such as unintentional or accidental food additives, human experience is unlikely to provide any meaningful indication of safety or hazard. Similarly, it is not possible to develop valid inferences concerning the safety of occupational exposure to particular chemicals or mixtures of chemicals in the absence of an adequate population sample which has been adequately followed up for several decades.

Scientific considerations apart, there are critical deficiencies in legislative and regulatory approaches to environmental pollutants, including conflicts of interest in the generation and evaluation of data, restrictions on open access to data, and lack of qualified representation of a wide range of concerned viewpoints and interest in decision making processes.

INTERNAL POLLUTION - OUR FIRST PRIORITY

A review of the studies of the Special Commission on Internal Pollution

OUTLINE from the Commission's Rapporteurs :

Peter Beaconsfield, Norman Borlaug, A. Carpi di Rismini,
Sir Hans Krebs, Sir Rudoph Peters, Rebecca Rainsbury

Special Commission on Internal Pollution, BMA House, London WC1, U.K.

ABSTRACT - Pollution is the result of man's unwillingness or inability to control his present overpopulation, over-exploitation of natural resources, and over-production of many indestructible goods.

However, attacking environmental pollution will be self-defeating if we disregard man's continuous and progressive pollution of his own milieu interieur - this is what we have termed internal pollution.

Internal pollution is brought about in three ways: by the ingestion and inhalation of the products of the already polluted external environment; by daily intake of chemical additives and impurities prepacked in food; and by the vast number of medicaments taken regularly, and more often than not unnecessarily.

Concern about the paucity of our knowledge, particularly in the long term, of the effects of this continuous ingestion of synthetic products led to our inquiry :

How has this chemical age affected the quality of life, and what is its effect on the economy, national progress, and health - now, and on generations to come?

Accordingly we resolved :

To consider the present use of chemicals under four broad headings - medication, food additives and colourants, agricultural aids, and household goods; and to relate their respective uses to the responsibility shared by the producers (that is, industry); the consumer; the government regulatory agencies, whose role is to protect the consumer; and the biomedical professions who test and prescribe many of these chemicals;

To examine the state of the chemical age in the last quarter of the twentieth century, with special reference to the benefit: risk ratio in the different classes of compounds mentioned above, and see how this ratio can be improved.

In the last year and a half we have examined the field of medications, and started our inquiries into food, which cannot be completely separated from agriculture since much food is processed in one way or another while still growing.

Observations and Findings on Medication

Widely publicised undesirable and unexpected side effects of drugs occur from time to time.

./.

The general impression was, particularly since thalidomide, that there is something wrong with the tests, but our investigations do not bear this out.

So what is wrong?

We find the tester and the physician to be the guilty parties.

Testers succomb to human weaknesses of inefficiency and lack of conscientiousness, especially if career structure and salary are poor.

Physicians are ill informed. Undergraduate teaching is almost exclusively concerned with diagnosis; therapeutics is rarely taught and there are no instructors in it because of the lack of esteem in which clinical pharmacologists are held by both practising physicians and academic pharmacologists.

Overprescribing and polypharmacy are the twin sins.

Finally, the patient may have unsuspected sensitivity or may be ignorant enough to believe that doubling the dose must double the benefit.

As the whole field of medication is in the control of experts this is one of the aspects of internal pollution capable of solution within the framework of our present technical and economic possibilities.

Observations and Findings on Food - Husbandry and Preparation

Pesticides, fertilizers, and other crop and livestock improvers have come into almost universal use. Concern has been expressed about the long-term risks some of these chemicals entrain. When evaluating this, and always looking to increase the benefit: risk ratio of such agricultural aids, it must be remembered that their use should be discussed within the context of the nutritional status of the population needing to be fed.

Preservatives, packaging aids, and so forth are the result in large measure of modern economic dictates concerning demand and supply, storage and distribution.

We accept these needs; we do not accept adulteration and alteration of food with possible consequent risk when this is done simply for commercial benefit, and we consider the public needs and deserves to be better informed about what is done to the food supply, and why.

* * *

We realize that an urgent need exists for clearer understanding of the medical, social, and economic benefits and risks that accrue from the application of science and technology and the use of chemicals in today's world, and better guide lines for decision-making.

The purpose of our endeavour is to enable us to inform and instruct the citizen on the causes of internal pollution and what is entailed in trying to remedy them. In a free society, at the end of the day it is the citizen who finally decides what kind of life he wants. It is our responsibility as scientists to see that he has the necessary knowledge to make the right decision.

BEHAVIORAL METHODS FOR INVESTIGATING ENVIRONMENTAL HEALTH EFFECTS

BERNARD WEISS

Department of Radiation Biology and Biophysics
University of Rochester School of Medicine and Denistry
Rochester, New York, U.S.A.

ABSTRACT - One may conceive of three phases in the assessment of behavioral changes induced by environmental contaminants. The first is the non-specific, or screening phase, during which a search is made for general CNS effects. The methodology employed stresses relatively simple techniques, partly because, for some agents, any CNS activity prohibits their use and partly because one aim is to estimate the relevant range of dose levels. These techniques encompass observational tests of unlearned behavior, and relatively simple learned behavior.

The second phase focuses on the specific functions that are affected; for example, sensory and motor function and complex discriminative processes. The pertinent techniques almost all involve highly-trained animals, and advanced instrumentation, including computers.

The third phase focuses on human health. Its purview extends from laboratory studies of complex functions to what might be called behavioral epidemiology. Naturally, it is the most difficult phase.

THE USE OF CANADIAN MEDICARE DATA IN DEFINING HEALTH EFFECTS OF THE ENVIRONMENT ON MAN

C. A. R. DENNIS

Prairie Institute of Environmental Health Saskatchewan, Canada

ABSTRACT - Since 1962, whenever a Saskatchewan resident attends a physician for an illness or injury, the physician is required to identify the diagnosis of the condition for which he has rendered a service; this identification of diagnosis is a requirement of payment for service. The diagnosis relating to each physician service a person receives becomes a part of that person's computerised patient history file and constitutes a complete record of physician services received. In a given population the patient history files of that population include a redord of the number, cost and diagnostic code of physician services to that population and allows comparison with other populations.

The paper outlines the utilization of the Canadian health data base in identifying health effects of the environment on man by illustrating with examples, how the Saskatchewan health data base has been so used.

The paper seeks to assess both the potential and the limitations of using the computerized information contained in Canadian medicare data sources.

THE ASSOCIATION BETWEEN LOWER LEVEL LEAD CONCENTRATIONS AND HYPERACTIVITY IN CHILDREN

OLIVER J. DAVID

State University of New York, Brooklyn, N.Y., USA

ABSTRACT - Hyperactive children were compared with a non-hyperactive control group on two measures that reflect the presence of body lead and on a lead exposure questionnaire.

The overall hypothesis that was tested, was that a relationship exists between hyperactivity in children and a concommitant condition of increased body lead stores. Operationally, the hypothesis was reduced to a comparison of the hyperactive group and control group on the following measures: (1) Blood lead levels; (2) Post penicillamine urine lead levels; (3) Scores on a lead exposure questionnaire. The designation hyperactive or non-hyperactive was arrived at by using 3 different measurements: (a) A doctor's diagnosis; (b) A teacher's rating scale; (c) A parent questionnaire.

Hyperactive children had significantly higher values on all three measures than did the controls. More than half the hyperactive children had blood-lead levels in the range considered to be raised but not "toxic", and 60% of post-penicillamine urine levels were in the "toxic" range.

It is concluded that there is an association between hyperactivity and raised lead levels, that a large body-lead burden may exact consequences that have been hither to unrealised; that the definition of what is a toxic level for blood-lead needs re-evaluation and that physicians should look for raised lead levels in children with hyperactivity.

INFLUENCE OF AIR POLLUTION ON PNEUMONOSES OF INFANCY AND CHILDHOOD

Dr. MARTIN ACKO

Institute of Pathomorphology, Medical Faculty in Ljubljana, Yugoslavia

---

ABSTRACT - In an analytic study of over two thousand cases of neonatal deaths and cases of deaths in infancy and early childhood we observed that in the last decade lung disorders, especially various pneumonoses and allergic diseases, are on the increase, simultaneously with an increses of motor-traffic and industrial emissions, which together with heating in winter-time represent the three main groups of air pollution sources in most areas.

The percentage that each of these groups contributes to the total pollutant output varies from place to place. The steadily increasing motor-traffic is becoming a more and more important air pollution source, especially as it pollutes the immediate neighbourhood of highways to an ever increasing extent.

Measurment of sulphur dioxide and smoke, which are the most common and dangerous air pollutants, has shown that the air in the major cities and industrial areas of our country is polluted, with minor exceptions, to such a high degree that such concentrations of sulphur dioxide and smoke have serious consequences for the health of people. It has been proved that there are great negative consequences resulting from the polluted air, especially for health of such a vulnerable and sensitive population group as this, the infants and children, however, we have also noted harmful consequences in adults and elderly individuals yet no particular data are as yet available. The total harm caused to human health by the polluted air, in our country has not yet been assessed.

We regard sulphur dioxide and smoke as the main indicators of air pollution because they are most widely spread and indeed always present in the air above populated industrial areas. Moreover, in the concentrations in which they are quite frequently to be found, they belong to the most dangerous air pollutants. The maximum permissible concentration (MPC) of sulphur dioxide, according to the expertise of the Federal Institute of Health Security, is 0.15 mg of SO_2 per cubic metre for an average value of 24 hours. High concentrations, which in the most threatened areas are more than twenty times the tolerable figure, naturally entail all the dire consequences of air pollution.

These pollutants also affect vegetation and cause a deterioration of climatic conditions. Though this country does not have very large industrial emissions, the high concentrations of the polluted air are more a consequence of the very unfavourable weather conditions, which prevent natural purification. In addition to SO_2 and smoke traffic emits into the air lead, nitrogen oxides, and certain substances, known as chemical carcinogens, mutagens and teratogens. The emission of these pollutants on one hand and the prevalence of lung disorders and allergic diseases on the other are both increasing.

../...

The tight connection between air pollution and the above mentioned anthropogenic diseases cannot be over-emphasized; too little has been done about improving methodology for measuring clinical effects and morphological changes from exposure to air pollutants and about the further development of protection against them. To bring the everincreasing air pollution under efficient control, a continued analytic study of health effects from exposure to air pollutants of the most sensitive population groups (including infants and children) has been completed using general national health data for a period covering the last ten years. For evaluation of clinical effects, clinical data have been considered, but most attention has been paid to the results of the necropsies of over 2000 cases of deaths of newborn babies and children.

Autopsy is indispensable for a successful statistical study and a uniform assessment of the results, incorporating the histological findings, based on improved histochemical, histometrical and electron-microscopic techniques under consideration of histo-topography of the involved parts of the lungs. Cases of acute poisoning with polluted air have not been included in our study. The majority of our observed cases belong to the perinatal age group (1,928 cases), the remaining 12,6% of all cases refer to death in childhood due to pneumonoses and respiratory diseases caused by allergy, which however are also on the increase. It has been established that in many cases oversensitivity is caused by polluted air (industrial dust, smoke, exhaust fumes, hop pollen etc.). Especially in cases of bronchial asthma these pollutants are of paramount importance.

The perinatal age group, which comprises nearly 88% of all cases, shows in its percentage distribution a steadily increasing share of pneumonoses with pulmonary hyaline membrane of the newborn from 29% to 37% only in the last hemidecade. The vast majority (85,7%) of this category are preterm infants with a birth weight around 1,400 grams, a particular sensitive population group, most of which (45,2%) are dying within 24 hours of birth. A correlation with the data on air pollution which is increasing, could be found. Moreover this suggests that a defect or an inadequat amount of the surface-active material (e.g. dipalmitoyl-lecithin), present in the normal lung and lining the inside of alveoli, is at least one of the major factors contributing to this syndrome. In this respiratory distress syndrome the surfactant (surface tension reducing agent), together with the alveolar lining layer is disrupted and dispersed and may sometimes be incorporated in the polmonary hyaline membranes.

It is not possible to regard the deficiency of surfactant in RDS as dependant on a congenital defect. It seems necessary to assume that the normal amount of surfactant which should be available at a given gestational age is destroyed or its production serioulsy curtailed by adverse influences.

In the lungs of adults similar pulmonary membranes after exposure to inhaled irritant chemicals are observed. Soon after birth various air pollutants at low levels of concentration seem the likely agent which may reduce the available surfactant, elaborated by the granular pneumocytes, by damaging the cells. Some progressive impairment of synthesis after birth could explain the clear interval of time often observed before symptoms start.

Our studies on newborn guinea-pigs provided some experimental support for this effect, the experimental production of hyaline membranes being caused by ventilating foetal lungs with various gas mixtures, mainly carbon dioxide and nitrogen and oxygen. Histologic analysis revealed similar hyaline membranes of the lung in the majority of exposed guinea-pigs, as they are found in the human lungs of the newborn.

UNTERSUCHUNGEN AN 12.000 PATIENTEN UEBER DEN EINFLUSS DER LUFTVERSCHMUTZUNG UND DES ARBEITSPLATZES AUF DIE HAEUFIGKEIT DER CHRONISCHEN BRONCHITIS

U. SMIDT, G. WORTH

Krankenhaus Bethanien, **Moers/Rhein**, Bundesrepublik Deutschland

KURZFASSUNG - Bei 12.000 stationär behandelten Patienten der Inneren Abteilungen von 5 Krankenhäusern des Kreises Moers wurden die Diagnosen, die Behandlungsdauer, der Verlauf und die Wohnlage festgestellt. Aus der Krankenkasse ergab sich ausserdem, ob der jeweilige Patient zum Steinkohlenbergbau gehört oder nicht.

Zur Beurteilung der Wirkung der Luftverschmutzung wurden die monatlichen Staub- und SO_2-Messwerte, die für jeden Quadratkilometer des Einzugsgebietes vorliegen, herangezogen. Die Auswertung ergibt bei den knappschaftlich versicherten Männern eine erheblich höhere Bronchitishäufigkeit als bei den nichtknappschaftlich versicherten Männern. Die Häufigkeit bei den Frauen liegt erheblich niedriger, zeigt jedoch zwischen Knappschaftsversicherten und Nichtknappschaftsversicherten nur geringe Unterschiede.

Diese Restdifferenz hängt möglicherweise mit der höheren Luftverschmutzung in den Wohngegenden der Knappschaftsversicherten zusammen.

INVESTIGATIONS OF 12,000 PATIENTS TO DETERMINE THE INFLUENCE OF ATMOSPHERIC POLLUTION AND THEIR PLACE OF WORK ON THE INCIDENCE OF CHRONIC BRONCHITIS

U. SMIDT, G. WORTH

Krankenhaus Bethanien, Moers/Rhein, Federal Republic of Germany

Abstract: 12,000 patients confined to bed in the inner wards of five hospitals in the Moers "Kreis" were investigated as regards their diagnosis, length of treatment, their progress and their domicile. Their insurance organisations were also asked whether the patient was involved in mining.

To determine the effect of atmospheric pollution the monthly dust and SO_2 values, which are available for each square kilometer of the relevant area, were used. This data showed a considerably higher incidence of bronchitis among the men in the miners' insurance organisations than the others. The incidence in the women was considerably lower, but only slight differences were found between those in the miners' insurance organisations and the others.

This slight difference may possibly be connected with the heavier pollution in the mining areas.

"ECO-GENETICS": HOST VARIABILITY IN HEALTH EFFECTS OF ENVIRONMENTAL AGENTS

GILBERT S. OMENN

U.S. Atomic Energy Commission and Division of Medical Genetics,
University of Washington, Seattle, USA

ABSTRACT - An important variable in assessing the effects of environmental agents upon living things is the genetically-determined variation in enzymes, cell surfaces, and immune responses of the host. Such genetic variation may influence spread of agents within the body, specific tissue vulnerability, rate of conversion of agents to active (toxic) forms of metabolism to inactive forms. Therefore, individuals may be at relatively high risk for mutagenic, carcinogenic, teratogenic, or inflammatory effects of common agents for which no statistically significant harm can be detected in over-all epidemiological investigations.

Certain inherited human disorders are known to make healthy persons more vulnerable to infectious or physical agents. Individuals deficient in the plasma protein alpha$_1$-antitrypsin are much more susceptible than normals to develop emphysema from chronic cigarette smoking and probably from other inhaled agents in the occupational and general environment. Many males of Mediterranean or Negro ancesrry are deficient in the enzyme glucose-6-phosphate dehydrogenase (G6PD), determined by a gene on the X chromosome. A long list of oxidizing agents can induce severe hemolytic anemia in those with G6PD-deficiency. Well-characterized genetic variation in acetylating and esterolytic enzymes causes severe adverse reactions from anti-tuberculous and muscle-relaxing drugs. Individuals with certain abnormal hemoglobins or erythrocyte enzyme defects are more susceptible to other drugs and carbon monoxide. Variation in cellular membranes, detected by histocompatibility testing, has been correlated with susceptibility to diseases probably triggered by viruses or by ultraviolet radiation. Variation in enzymes of the DNA repair mechanisms may greatly influence mutagenic effects. Abnormalities in humoral and cellular immunity increase the risk of bacterial and fungal infections, as well as of neoplastic transformation.

Other types of vulnerability result from the action of the host on the agent. The risk of developing cancer of the lung is much higher among people who have the genetic trait of high-inducibility of aryl hydrocarbon hydroxylase (an enzyme that forms carcinogenic epoxides from aromatic hydrocarbon compounds in cigarette smoke and other emissions) compared with individuals whose enzyme level is increased very little by such exposure. This enzyme also is induced by insecticides.

One may anticipate practical screening methods to recognize individuals at much higher than "normal" or "acceptable" risk to specific agents in defined occupational or geographic environments.

POLLUTION AND POPULATION CONTROL: COPPER INTRAUTERINE DEVICES

I. HERBERT SCHEINBERG

Albert Einstein College of Medicine Bronx, New York, U.S.A.

ABSTRACT - Environmental pollution injures people, and people generate environmental pollution. Therefore, the control of pollution and the control of population growth are inextricably intertwined. A peculiar dilemma results from this interaction: copper-containing intrauterine contraceptive devices are one of the most effective ways of controlling population growth but these devices may themselves constitute a potential health hazard from copper toxicity.

The advantages of copper IUDs are significant. They are about as effective as oral contraceptives; they cause less bleeding, spontaneous expulsion, perforation and discomfort than non-copper-cantaining IUDs. Most important for large populations of illiterate or semi-literate peoples, their use does not involve any active participation on the part of woman or man in the contraceptive process: no pills to take or calendars to consult, and no repetitious application and removal of condoms or diaphragms.

However, two sets of data have raised the possibility that systemic copper toxicity may result from copper IUDs: radioactive copper has been found in the blood and livers of rats following intrauterine insertion of radioactive copper wire; and copper absorbed during the course of chronic hemodialysis has accumulated in the livers of several patients. Pending determination of whether absorption of copper or its effects on the endometrium are of pathologic significance, the United States Food and Drug Administration has classified copper-containing intrauterine devices as an Investigational New Drug not yet approved for marketing.

The dilemma is susceptible to a practical solution. Clinical experience with Wilson's disease -- the only known form of chronic human copper toxicity -- makes it very likely that copper toxicity from copper IUDs will require years to develop, will first affect the liver, and, if detected, early, can then almost certainly be effectively reversed by the use of D-penicillamine. Therefore, provisional approval of copper IUDs and continued analyses of liver biopsies of a representative number of women using these devices should make them safe.

Copper has acted as a pollutant capable of causing mild, acute toxicity when acidic foods or beverages -- citrus-juices, for example -- are allowed to remain in contact with copper plumbing or vessels for more than a few minutes. Further, copper contained in the semi-permeable membranes or solutions used in chronic hemodialysis has been found to accumulate in the livers of patients undergoing such treatments. And Wilson's disease represents copper toxicity -- caused by the amounts of the metal unavoidably present in almost any diet -- but occurring only in those few individuals who inherit an autosomal recessive abnormality of copper metabolism. Thus, in considering copper as a pollutant occasionally dangerous to health, but specifically potentially so when present in an IUD, one must evaluate (1) whether the copper balance is achieved equally if the metal is introduced into the body via the gastrointestinal tract, or parenterally; and (2) whether or not the exposed individuals are homozygously or heterozygously abnormal for the "copper balance" gene.

THE EFFECTS OF PARTICULATE AIR POLLUTION ON EXPECTATION OF LIFE

T.J. THOMAS, D.W. MALONE

Battelle Columbus Laboratories, Columbus, Ohio, USA

ABSTRACT - A Technique was developed by which the effect of particulate air pollution on expectation of life could be quantified and thus utilized in regional air pollution planning. The methodology was then applied to a regional air shed in order to demonstrate the loss of human functionality incurred for various emission control policies.

Expectation of life, broken down by age, race, and sex, and calculated from observed mortality rates, was related to particulate air pollution using regression analysis applied to data collected for the year 1960. The observations for the regression were based upon standard metropolitan statistical areas. Many explanatory variables were included in the regression analyses, requiring compensation in the regression procedure for the nonorthoganality of the explanatory variables. This compensation procedure increases the confidence of the results and greatly decreases the effect of corelated explanatory variables on the regression coefficients of the pollution variables.

A test region, consisting of an adequately documented environmental study area, was selected to provide air pollution concentrations (doses) over the region for five proposed sets of air pollution control regulations. The demographic characteristics of the region were utilized to integrate per capita losses over the age, race, sex, and location variables.

Conclusions

The results of the methodology applied to the test region were used to address three hypotheses. Two conclusions reached were:

(1) Expectation of life is an important parameter to measure the effect of air pollution on mortality, and has the advantage of being commensurable with economic loss.

(2) The change in expectation of life due to particulate air pollution is quite large. An average loss rate for the test area is approximately 2 days per year per capita.

In this study, an improvement to ridge regression analysis is proposed. The equations for weighted ridge regression are developed, and the resulting coefficients are shown to have a smaller variance than those of unweighted ridge regression. It is also demonstrated that changes in air pollution emission rates do not significantly alter health effects related to the standard geometric deviation of air pollution concentration.

ILLNESS DUE TO ENVIRONMENTAL POLLUTANTS IN A PHYSICIAN'S PRACTICE

G.L. WALDBOTT

Warren, Michigan USA

ABSTRACT - Practicing physicians are frequently confronted with ilness due to environmental pollution, but many lack the diagnostic tools for its recognition. Relatively little information is abailable to the physician on the clinical aspect of such diseases in contrast to an abundance of literature pertaining to the biochemical and epidemiological approach.

This paper attempts to bridge this gap. Data have been gleaned from acute pollution episodes and from chronic low-grade exposure to environmental pollutants which leads to slowly progressive illness. The patient's history, physical and laboratory findings are correlated with available environmental data and elucidated by brief case reports. The modus operandi of respiratory pollutants is discussed in distinction to systemic airborne poisons which enter the system via the gastrointestinal tract. The target organs of the major environmental pollutants are presented diagramatically and the diagnostic features of illness due to air pollution are tabulated.

ASSESSMENT OF THE HEALTH EFFECTS CAUSED BY CHRONIC EXPOSURE TO SOLVENTS

PIETRO U. CAPURRO

Department of Pathology, Union Hospital of Cecil County Elkton,
Maryland, USA

ABSTRACT - More than one hundred people who were exposed to solvents of different types were studied. Most of these people were exposed to air pollution caused by a chemical plant that recovers solvents from discarded chemicals and others working for industry.

The air and the water in the area of the chemical plant were studied with gas chromatography and mass spectrometry for more that 2,000 hours. Distribution of chemical vapors in the atmosphere was studied.

The effects on the people were studied especially with insulin immunoassay, glucose tolerance, liver scan, pancreas scan and lung scan. With these methods, the organ most damaged was found to be the pancreas, followed by the lung and liver. Kidney damage was also noted. Many people, including children, complained of pain in the extremities.

A strong suggestion of increased rate of malignancies was found in the area where the chemical plant was present, such as two carcinoma of the pancreas. The youngest patient with carcinoma of the pancreas was a 21 year old man. There were two cases of carcinoma of the larynx and four cases of malignancy of the blood-forming organs.

Zinc blood levels and zinc urinary excretion studies were done and changes found.

CONTRIBUTIONS A LA RECHERCHE DE L'INFLUENCE DE LA POLLUTION DU MILIEU SUR L'ORGANISME ET LA SANTE DES COLLECTIVITES

HUGO STRAUS
Faculté de Médecine, Cluj, Roumanie

RESUME - On décrit l'expérience de la Chaire d'Hygiène concernant la méthodologie d'étude des effets nocifs de la pollution du milieu sur la santé des collectivités.

On présente des données concernant les effets de la pollution sur l'organisme et la santé publique (les effets de la pollution atmosphérique sur la morbidité, des expériences sur des animaux concernant la pollution de l'eau avec des détergents, insecticides et nitrates, et l'influence sur l'organisme).

On expose le point de vue de l'hygiène dans l'élaboration des conditions sanitaires requises pour la lutte contre la pollution et pour la protection de la santé de la population.

CONTRIBUTIONS TO RESEARCH ON THE EFFECTS OF ENVIRONMENTAL POLLUTION ON THE SYSTEM AND ON THE HEALTH OF THE COMMUNITY

HUGO STRAUS

Medical Faculty, Cluj, Rumania

ABSTRACT- A description is given of the experience of the Department of Hygiene as regards the methodology of studies on the harmful effects of environmental pollution on the health of the community.

Data are reported for the effects of pollution on the system, and on public health (effects of atmospheric pollution on morbidity and experiments on animals to investigate the pollution of water by detergents, insecticides and nitrates, and their effects on the organism).

Details are given, from the point of view of hygiene, of the sanitary conditions which are a requirement for the control of pollution and the protection of the health of the population.

INCIDENCE DE CERTAINES MALADIES CHEZ LA POPULATION DE DEUX CENTRES FORTEMENT INDUSTRIALISES, COMPARATIVEMENT A TROIS LOCALITES TEMOINS

MAURICE DELEANU, NAUM W. GHELBERG, IULIU LENGHEL, NERVA MOLDOVAN

Institut de Santé Publique et de Recherches Médicales,
Cluj, Roumanie

RESUME - La morbidité a été étudiée comparativement chez la population de 2 centres à l'atmosphère intensivement polluée par des industries de divers profiles, et chez la population de 3 villes témoins dont l'atmosphère urbaine est exempte de pollution intense et spécifique.

Méthode

Etant donné l'uniformité de l'organisation de l'assistance médico-sanitaire urbaine, l'accessibilité élevée et la standardisation du système d'enregistrement des cas de maladies en Roumanie, on a eu recours à une étude comparative de certaines maladies pour lesquelles il existe dans la littérature des données sur une corrélation possible avec les conditions de la pollution atmosphérique.

Les rapports mensuels des circonscriptions médicales sur le nombre de case nouveaux (incidence) des maladies ont servi en tant que données primaires. On a fait d'abord une sommation du nombre des cas nouveaux des maladies enregistrées au cours de la respective année. Puis on a rapporté ce nombre des cas à 1000 habitants, adultes ou enfants. (Les circonscriptions possèdent des données annuelles concernant l'évolution de la population). Le calcul en cette manière des données de l'incidence des maladies a porté sur une période de 7 ans (1963-1969). Afin de minimaliser les différences annuelles, on a calculé les moyennes des fréquences annuelles des maladies sur la période analysée.

La moyenne de l'incidence des maladies a été calculé de manière analogue pour les 3 localités témoins, cette incidence étant considérée égale à l'unité (incidence conventionnelle = 1,0).

La pollution atmosphérique a été considérée en tant que facteur favorisant l'incidence de certaines maladies seulement lorsque l'incidence de celles-ci dans le centre industriel dépassait 2,0 fois pour les enfants, ou 2,5 fois pour les adultes l'incidence des mêmes maladies dans les localités témoins (incidence conventionnelle plus de 2,0 ou 2,5).

./.

Résultats

Dans un centre avec une puissante industrie chimique et de métallurgie non-ferreuse, une incidence significativement plus élevée a été constatée pour les maladies suivantes : bronchite chronique, hypertension artérielle, artériopathie coronarienne chronique, athérosclérose, ulcère gastro-duodénal, anemies - chez les adultes; infections aigues des voies respiratoires supérieures, bronchite chronique, anémies et rachitisme - chez les enfants.

Dans un centre avec industrie chimique et de matériaux de construction, une fréquence accrue a été constatée pour certaines maladies respiratoires, cardiovasculaires et digestives - chez les adultes, si bien que pour certaines affections respiratoires et le rachitisme - chez les enfants.

On discute les avantages et désavantages de la méthode employée; on discute également le rôle du facteur de risque représenté par la pollution atmosphérique urbaine pour expliquer les différences de morbidité constatées à l'occasion de cette étude.

INCIDENCE OF CERTAIN DISEASES IN THE POPULATION OF TWO HIGHLY INDUSTRIALISED CENTRES, COMPARED WITH THREE CONTROL LOCALITIES

MAURICE DELEANU, NAUM W. GHELBERG, IULIU LENGHEL, NERVA MOLDOVAN

Institute of Public Health and Research, Cluj, Rumania

ABSTRACT- A comparative morbidity study was made of the population of two centres with an atmosphere extensively polluted by various types of industry, and the population of three control towns whose urban atmosphere has no intense or specific pollution.

Method

The uniform organisation of the urban medical health scheme, a high degree of accessibility and the standardisation of the registration system for cases of disease in Rumania enabled us to undertake a comparative study of certain kinds of disease for which data on a possible correlation with atmospheric pollution conditions exist in the literature.

The monthly reports from the different medical districts on the numbers of new cases (incidence) of diseases were used as primary data. First of all, the total number of new cases of diseases recorded during the year in question was calculated and from this total, the number of cases per 1,000 inhabitants, adults or children, was ascertained. (The various districts keep data on population changes during the year.) This calculation of data on the incidence of the diseases referred to a period of 7 years (1963-1969). The mean annual incidence of the diseases was calculated over the period analysed, in order to minimise the differences from year to year.

The mean incidence of these diseases was calculated by analogy for the 3 control localities, this incidence being considered as unity (conventional incidence = 1.0).

Atmospheric pollution was considered to be an influential factor as regards the incidence of certain diseases only when the incidence in the industrial centre was more than twice (in the case of children) or 2.5 times (in the case of adults) the incidence of the same diseases in the control localities (conventional incidence more than 2.0 or 2.5).

·/.

Results

In a centre with extensive chemical and non-ferrous metal works, a significantly higher incidence was established for the following diseases: in adults, chronic bronchitis, hypertension, chronic coronary arteriopathy, atherosclerosis, gastro-duodenal ulcer, anaemia; in children, acute infections of the upper respiratory passages, chronic bronchitis, anaemia and rickets.

In a centre with a building materials and chemical industry, an increase was noted in the frequency of certain respiratory, cardio-vascular and digestive diseases in adults, and certain respiratory troubles and rickets in children.

The advantages and disadvantages of the method used are discussed, along with the extent to which the risk factor represented by urban atmospheric pollution explains the differences in morbidity established by this study.

L'EVALUATION PAR DES METHODES PHYSIOLOGIQUES DES MODIFICATIONS FONCTIONNELLES PROVOQUEES PAR LE TRAVAIL ET LES FACTEURS D'AMBIANCE

ION ANGHEL et MIHAELA ANGHEL

Chaire de physiologie de l'Institut de Médecine et de Pharmacie,
Cluj, Roumanie

RESUME - L'étude concerne 15 téléphonistes (agées de 22 à 44 ans et stage de 3 à 14 ans) explorées deux fois à un intervalle de 2 à 3 jours avant et après le travail professionnel qui comportait une sollicitation intense, y compris un bruit élevé, jusqu'à 86 dB (groupe A).

Dix femmes de ce groupe ont été examinées pendant le travail de nuit quand la charge est plus réduite et le bruit ne dépasse pas 55 dB, les limites admises dans ce travail (groupe B).

Sept téléphonistes du groupe A ont été explorées, à des heures analogues pendant une journée de répos (groupe C).

Les méthodes utilisées étaient les suivantes :

- épreuve dynamographique de stabilité de compression manuelle, variante élaborée par Baciu- Derevenco-Anghel, et vérifiée dans de nombreuses recherches; ce test donne des informations objectives sur la coordination sensori-motrice et surtout sur la kinesthésie;
- temps de réaction motrice à des stimuli acoustiques et optiques;
- le seuil critique de fusion des stimuli lumineux intermittents;
- la sensation de fatique établie par le questionnaire de Dirken et l'état de confort évalué d'après Grandjean.

Les calculs statistiques intéressaient l'erreur standard, les coefficients de corrélation entre les résultats des épreuves et des histogrammes des résultats individuels.

CONCLUSIONS :

a) Tous les indicateurs démontrent, chez le groupe A (travail intense + bruit élevé), une détérioration significative de la performance après le travail en comparaison avec l'état initial.

b) Chez le groupe B (sollicitation et bruits modérés) manquent des modifications physiologiques significatives après le travail.

c) Des résultats analogues ont été obtenus chez le groupe C (en repos).

d) Ces résultats montrent le rôle négatif du bruit professionnel, traduit par l'abaissement de la capacité fonctionnelle de l'organisme liée au travail, la valeur de certaines méthodes physiologiques pour évaluer l'influence du bruit et de la charge et la nécessité d'améliorer l'ambiance du travail par des mesures ergonomiques.

PHYSIOLOGICAL METHODS OF EVALUATION OF FUNCTIONAL CHANGE CAUSED BY WORK AND ENVIRONMENTAL FACTORS

ION ANGHEL, MIHAELA ANGHEL

Professor of Physiology at the Institute of Medicine and Pharmacy,
Cluj, Roumania

ABSTRACT - The study was based on 15 telephonists aged between 22 and 44, who had been in this employment between 3 and 14 years. They were examined twice, at intervals of 2 - 3 days before and after work. The number of telephone calls was high, and involved a high noise level, up to 86 decibels (Group A).

Ten women from this group were examined during night work, when there were fewer calls and the noise level did not exceed 55 decibels, the limit stipulated for this work (Group B).

Seven telephonists of Group A were examined at similar times during a day of rest (Group C).

The methods used were as follows :

- dynamographic testing of manual compression stability. The test used was a modification developed by Baciu-Derevenco-Anghel, which has been proved in a number of items of research work. It provides objective information on sensor-motor coordination, and particularly on kinesthesia;
- motor reaction time to acoustic and optic stimuli;
- critical fusion threshold to intermittent light stimuli;
- tiredness as established by Dirken's questionnaire, and comfort assessed after Grandjean.

The statistical calculations covered the standard error, the coefficients of correlation between the results of the tests, and the histograms of individual results.

Conclusions

a) In Group A (intense work and high noise level) all indicators showed significant deterioration of performance after work as compared with the initial state.
b) In Group B (moderate level of work, moderate noise level) there were no significant physiological changes after work.
c) Similar results were obtained in Group C (at rest).
d) These results show the detrimental effect of occupational noise, as evidenced by a work-related decline of functional capacity; the value of certain physiological methods for assessing the effect of noise and workload; and the need to improve the working environment by ergonomic measures.

BONE MARROW CHANGES IN ASBESTOSIS

A.Z. EL-SEWEFY, H. SHAHEEN, A. SHAMS EL-DEEN

Industrial Medicine, El Saad Building, El Batha Street, Riaydh, Saudi-Arabie

ABSTRACT - Seventeen workers from an Egyptian asbestos-cement pipe factory exposed to asbestos dust, and seldom exposed to silica & cement dust for a period of 10 - 26 years of age range from 30 - 57 years were examined clinically, radiologically, and hematologically including bone marrow puncture.

The result showed a state of leucopenia, increased sedimentation rate, the bone marrow showed a marked to extreme degree of generalised hyperplasia, the outstanding feature is the marked increase in the number of reticulum cells, some of them are immature & binucleated.

These results are discussed in the text.

BEHAVIOUR OF RATS AND THE THRESHOLD LIMIT VALUE OF TRICHLOROETHYLENE

A.P. SILVERMAN, HELEN WILLIAMS

Industrial Hygiene Research Laboratories, ICI, Macclesfield, Cheshire, UK

ABSTRACT - Objective evidence concerning health effects of low doses of a solvent like trichloroethylene (TCE) will probably continue to come largely from tests of animal behaviour, because its main toxic action is on the central nervous system and because the long-term, low-dose evidence from man may be considered subjective.

Groups of 16 male rats were exposed singly to TCE vapour at 100 ppm (535 mg TCE/M^3 or 200, 500 or 1000 ppm for 5 x 6 hours a week for about 5 weeks (12 weeks at 100 ppm). Social behaviour was observed, usually once a week, in the 5 min immediately following exposure. Control rats show their highest spontaneous activity on return to the home cage after daily seperation, and TCE reduced this activity. In a social situation, activity is of several kinds but, unlike most centrally-active drugs, the reduction due to TCE was fairly uniform with little evidence of stimulation or depression of any one kind of behaviour.

The fall in activity due to TCE was significant after 1 day at 1000 ppm. Following 100ppm, activity fell after 1 day in one group of rats, but after 1½ weeks in another and as much as 3½ weeks in a third.

In a test of exploration and learning in an unfamiliar cage, thirsty rats exposed to TCE were quicker than controls to find water and begin drinking. The rate of exploratory movement was unaffected.

The present threshold limit value for TCE in Britain is therefore not a no-effect level. Tentative interpretations of the effects are

1) that a fall in the highest rate of spontaneous activity is consistent with the drowsiness and fatigue complained of by exposed humans, and
2) that a low dose of an anaesthetic might well be expected to lead to a slight loss of inhibitory control in an unfamiliar situation.

MUTAGENITAET-VORTESTE AUF CARCINOGENE WIRKUNGEN VON UMWELTCHEMIKALIEN

HANS MARQUARDT

Universität Freiburg Br., Forstbotanisches Institut, BRD.

KURZFASSUNG - Gegenüber den akuten Schädigungen durch Umweltfaktoren werden auch heute die sogenannten Spätwirkungen wenig beachtet. Sie treten erst in einem grösseren zeitlichen Abstand von der Einwirkung auf; hierzu gehören die im Erbgut induzierten Mutationen (Mutagenese) sowie die Auslösung von Krebs (Carcinogenese). Zwischen beiden Wirkungen haben neuere Untersuchungen einen engen Zusammenhang wahrscheinlich gemacht. Auf Grund eines mutagenen Effektes einer Substanz kann daher mit einiger Sicherheit auch auf eine carcinogene Wirkung geschlossen werden. Mutationsprüfungen können bei geeigneter Methodik somit als Vortest auf eine carcinogene Wirkung verwendet werden.

Ziel der Mutationsprüfungen muss es sein, die wesentlichsten Typen der Mutationsereignisse zu erfassen, eine weitgehende Uebertragbarkeit der experimentellen Ergebnisse auf den Menschen zu erreichen und eine benefit/risk-Abschätzung zu ermöglichen.

Da Mutationen erst in den Folgegenerationen nach einer Einwirkung sichtbar werden, sind in erster Linie Methoden zu ihrer Erfassung in den Keimzellen von Säugetieren (Nagern) entwickelt worden. Der Dominant-Letaltest bei Maus oder Ratte sowie die Untersuchung praemeiotischer, meiotischer und postmeiotischer Zellen in der Keimzellentwicklung erlauben den Nachweis von Mutationen der Chromosomen. Die zweite grosse Gruppe, die molekularen Mutationen, werden dabei nicht erfasst. Hierfür müsste die sehr aufwendige specificlocus-Methode der Maus eingesetzt werden.

Wird die Mutationsprüfung gleichzeitig als Vortest für eine carcinogene Wirkung einer Substanz durchgeführt, dann müssen in erster Linie somatische Zellen untersucht werden. Auf Grund vorliegender experimenteller Erfahrungen schlagen wir dabei das folgende methodische Spektrum vor:

1) Zur Erfassung der Chromosomenmutationen
   a. Behandlung von Säugetieren (Nager) mit der zu prüfenden Substanz. Untersuchung des Knochenmarks während und nach der Behandlung auf Chromosomen-Mutationen.
   b. Als Ergänzung Entnahme von Blut dieser Tiere. Ansatz von Kulturen ebenfalls zum Nachweis von induzierten Chromosomen-Anomalien.

2) Zur Erfassung von molekularen Mutationen (Aenderungen der Basensequenz der DNA):
   a. In dieselben Tiere werden Mikroorganismen (Bakterien, Hefen) in die Bauchhöhle, in die Blutbahn oder in den Harn der behandelten Tiere gebracht. Nach Entnahme kann an den Mikroorganismenstämmen die genetische Wirkung der im Säugerstoffwechsel entstandenen Metabolite getestet werden.
   b. Um kurzlebige oder in den Körperflüssigkeiten zu verdünnt vorhandene Metabolite zu erfassen, wird ein in vitro-System aus Lebermikrosomen, der zu prüfenden Substanz und der geeigneten Mikroorganismen-Stämme verwendet.

MUTAGENIC AND CARCINOGENIC PROPERTIES OF CHEMICALS IN THE ENVIRONMENT

H. MARQUARDT

Freiburg University, Forstbotanisches Institut - Federal Republic
of Germany

Abstract: Even today the so-called delayed effects of factors in the environment which cause severe damage receive little attention. They make their first appearance at a large distance in time from their actual occurrence, taking the form of hereditary mutations (mutagenesis) and the outbreak of cancer (carcinogenesis). Recent investigations appear to have established a close connection between these two effects. If a substance has a mutagenic effect it is fairly certain that it will also have a carcinogenic effect. Using suitable methods mutation tests can also be used as preliminary tests for a carcinogenic effect.

The aim of the mutation tests must be to discover the most basis types of mutation phenomena, to achieve a high degree of transferability of experimental results to man and to enable a benefit/risk evaluation to be made.

Since mutations only appear in subsequent generations to the generation affected methods were initially developed to detect them in the germ cells of mammals (rodents). The dominant lethal test in mice and rats and the investigation of premeiotic, meiotic and postmeiotic cells in the development of the germ cells has produced evidence of mutations in the chromosomes. This test did not detect the second large group, the molecular mutations. To do this the extremely large scale specific locus method must be used on mice.

When the mutation test is also used as a preliminary test for the carcinogenic effects of a substance somatic cells must first be examined. On the basis of current experimental knowledge we suggest the following methods:

1. To determine the chromosome mutations: -

    a) treat mammals (rodents) with the substance under test. Examine the marrow during and after the treatment for chromosome mutations.

    b) as a complementary test take blood samples from these animals. Also introduce cultures to detect induced chromosome anomalies.

./.

2. To detect molecular mutations (changes in the sequence of bases in the DNA):

   a) Micro-organisms (bacteria, yeast) are introduced into the abdominal cavity, the blood stream or the urine of these same animals. After taking a sample the stock of the micro-organisms can be tested for the genetic effect of the metabolites which have occurred in the change in the animals' milk.

   b) To detect the presence of metabolites which are short lived or too deficient in the body fluids an _in vitro_ system is used comprising liver microsomes, the substance under test and appropriate micro-organism cultures.

LES CHAINES TROPHODYNAMIQUES MARINES EXPERIMENTALES: METHODE D'ETUDE DES EFFETS PATHOLOGIQUES CONSECUTIFS AUX POLLUTIONS CHIMIQUES

M. AUBERT, B. DONNIER

C.E.R.B.O.M. - I.N.S.E.R.M., Nice - France

RESUME - Le danger des pollutions chimiques de la mer tient aux capacités de concentration de certains de ces polluants au niveau d'espèces marines. Ce fait peut entraîner des taux élevés de ces substances souvent toxiques, principalement dans les derniers échelons des chaînes biologiques, qui sont habituellement livrés à la consommation.

Il y a plusieurs années, nous avons mis au point une méthode originale qui consiste à recréer en laboratoire des chaînes trophodynamiques marines, typiques des principales biocénoses, à leur soumettre pendant des temps plus ou moins prolongés et à des concentrations progressives les produits polluants que l'on désire étudier et à en lire les résultats à travers le comportement biologique et l'imprégnation chimique de leurs constituants.

Cette méthodologie, que nous utilisons d'une manière systématique, permet:

- de mesurer la destruction produite au niveau d'organismes types représentant divers échelons les plus caractéristiques de chaînes trophodynamiques marines. Par ce moyen, il est possible d'évaluer la destruction en capital des ressources biologiques de la mer;

- de tenir compte de l'ensemble des phénomènes de concentration et de biodégradation des substances chimiques soumises à ces tests et de juger des effets biologiques induits par la toxicité initiale ou secondairement apparus, ces produits chimiques passant à travers le milieu et étant absorbés successivement par les divers éléments vivants.

- enfin, par l'introduction d'un consommateur final mammifère, de juger des phénomènes toxiques en fin de chaîne et de mesurer le danger encouru par l'Homme nourri de produits marins pollués. Cet aspect hygiéniste débouche ainsi sur les impacts de la pollution marine vis-à-vis de la Santé Publique.

C'est ainsi que nous avons mis au point quatre types de chaînes trophodynamiques:

- La chaîne de type pélagique, c'est-à-dire: phytoplancton - zooplancton - poissons - mammifères;
- La chaîne de type néritique à mollusques, c'est-à-dire: phytoplancton - mollusques - mammifères;
- La chaîne de type néritique à crustacés, c'est-à-dire: micro-organismes marins - invertébrés - crustacés - mammifères;
- La chaîne de type benthique, comprenant: micro-organismes marins - invertébrés - poissons benthiques - mammifères.

./.

Ainsi, une chaîne biologique peut être utilisée à différentes fins.

1) Recherche des seuils de toxicité.

En mettant en contact chacun des échelons de la chaîne envisagée avec le polluant (produit chimique pur, ou effluent industriel) à différentes concentrations, on peut déterminer avec une assez grande précision la sensibilité de chaque espèce à ce polluant. On peut ainsi définir pour chaque échelon un seuil toxique.

Les résultats permettent donc une prévision à court terme des conséquences du rejet de ces polluants en mer sur la survie des espèces et de définir les risques de perte en capital nutritionnel.

2) Recherche des effets de la biodégradation d'un polluant.

Lors de son rejet en mer, un polluant peut servir de substrat aux bactéries marines et donc subir une biodégradation. Un tel effet peut entraîner une variation de la toxicité du polluant vis-à-vis des différents échelons marins de la chaîne biologique.

Les résultats rendent compte de la variation de la toxicité d'un polluant après contact avec l'eau de mer.

3) Recherche du transfert et de la concentration de substances toxiques.

Ayant déterminé les seuils de toxicité directe d'un effluent, nous choisissons la concentration maxima permettant la survie totale de tous les échelons de la chaîne marine: de cette façon la substance toxique pourra être transmise d'un échelon à l'autre et éventuellement concentrée au cours des différentes étapes sans que la chaîne biologique soit rompue par la mort d'un des intermédiaires.

Les résultats permettent d'évaluer les risques de la consommation par l'Homme des produits marins et ainsi les dangers éventuels vis-à-vis de la Santé Publique.

EXPERIMENTAL MARINE TROPHODYNAMIC CHAINS: METHOD OF STUDYING THE PATHOLOGICAL EFFECTS OF CHEMICAL POLLUTION

M. AUBERT, B. DONNIER

C.E.R.B.O.M. -(I.N.S.E.R.M.) NICE - France

ABSTRACT -The danger of chemical pollution of the sea results from the concentration capacity of certain pollutants in marine species. This fact can give rise to high concentrations of these frequently toxic substances, chiefly in the last links in the biological chains, which are usually those consumed.

Several years ago we devised an original method by which marine trophodynamic chains, representing the main biocoenoses, are recreated in the laboratory and exposed for varying periods and in progressive concentrations to the pollutants under consideration. The results are obtained by evaluating the biological behaviour and chemical impregnation of their components.

This systematically employed methodology enables us:

- to measure the destruction caused in organisms typifying the various most characteristic links of marine trophodynamic chains. By this means it is possible to estimate the destruction as a function of the biological resources of the sea;

- to take into account all the phenomena of concentration and biological decomposition of the chemical substances subjected to these tests and to assess the biological effects of the initial or secondary toxicity produced when these chemicals traverse the environment and are successively absorbed by various living organisms;

- lastly, by using a mammal as the final link in the chain, to estimate the toxic effects at this stage and to assess the danger involved in human consumption of polluted sea-food. This health aspect is therefore tied up with the affect of marine pollution on public health.

Thus we have set up four types of trophodynamic chain:

- The pelagic chain, viz. phytoplankton - zooplankton - fish - mammals;
- The molluscan neritic chain, viz. phytoplankton - molluscs - mammals;
- The crustacean neritic chain, viz. marine micro-organisms - invertebrates - crustacea - mammals;

./.

- The bentnic chain, viz. marine micro-organisms - invertebrates - fish - benthons - mammals.

Thus the same biological chain can be used for different purposes.

1) Research on toxicity levels.

By exposing each link of the chain in question to varying concentrations of the pollutant (pure chemical, or industrial effluent) the sensitivity of each species can be fairly accurately determined. Thus a toxicity threshold can be defined for each link.

The results enable us to make a short-term forecast of the effects of depositing these pollutants in the sea on the survival of the various species and to define the risks of nutritional loss.

2) Research on the effects of the biological decomposition of a pollutant.

When deposited in the sea, a pollutant may serve as a substrate for marine bacteria and so undergo biological decomposition. Such an effect can lead to a change in the toxicity of the pollutant to the different marine levels of the biological chain.

The results record the change in toxicity of a pollutant after contact with sea water.

3) Research on the transfer and concentration of toxic substances.

After establishing the levels of direct toxicity of an effluent, we select the maximum concentration allowing complete survival of all links in the marine chain: in this way the toxic substance can be transmitted from one link to the other and, if need be, concentrated during the different stages without the biological chain being broken by the death of one of its intermediate parts.

The results enable us to assess the risks involved in human consumption of sea-food and thus the possible dangers to public health.

VERSUCHE ZUR MEDIZINISCHEN BEDEUTUNG DES GLEICHFELD- ODER FARADAYEFFEKTES; BAUTECHNISCHE FOLGERUNGEN

J.R. MÖSE

Hygiene-Institut der Universität Graz, Universitätsplatz 4, OESTERREICH.

KURZFASSUNG - Zur Gestaltung optimaler gesundheitlicher Erfordernisse eines Raumklimas ist die Konstanterhaltung der konventionellen Klimafaktoren wie z.B. Lufttemperatur, Luftfeuchte und Wärmeabstrahlung keineswegs ausreichend. Nach neueren Erkenntnissen sind zur Erstellung eines gesunden Raummilieus auch luftelektrische Faktoren mit zu berücksichtigen.

Veränderungen natürlicher Gleichfeldbedingungen sind in geschlossenen Massivbauten vorzufinden.

Die günstigen physiologischen Wirkungen des ungestörten elektrostatischen Gleichfeldes wurden anhand umfangreicher Versuchsserien an Laboratoriumstieren nachgewiesen, die folgenden Umweltbedingungen ausgesetzt worden waren:

1) Versuchsraum mit positiv gerichtetem homogenem elektrostatischen Gleichfeld.
   Dieses, ungestörten atmosphärischen Bedingungen entsprechende Umweltmilieu führte zu einer Erhöhung der Vitalaktivität (Motilität, Futter und Trinkwasserverbrauch), Steigerung des Sauerstoffverbrauches der Leber sowie von Succinat- und Glutamatdehydrogenase in Lebermitchondiren und einer Erhöhung der Antikörperbildung.

2) Versuchsraum mit Faraday-Wirkung.
   Die bioklimatologischen Umweltbedingungen gleichen dabei z.T. jenen, welche in geschlossenen Massivbauten, vor allem solchen mit Stahlarmierungen vorzufinden sind. Alle vorhin genannten physiologischen Messparameter waren extrem erniedrigt bzw. reduziert. Bemerkenswert vor allem die niedrige oder fehlende Antikörperproduktion.

3) Versuchsraum unter den üblichen Umweltbedingungen eines nicht klimatisierten Laboratoriums.

   Die Messgrössen nahmen Werte an, welche zwischen den im Gleichfeld und Faradayraum erzielten Ergebnissen lagen.

Aus diesen Befunden ergeben sich praktische Schlussfolgerungen hinsichtlich der Bauweisen bzw. der Schaffung von künstlichen, optimal gesundheitsfördernden luftelektrischen Verhältnissen.

TESTS TO ESTABLISH THE MEDICAL IMPORTANCE OF THE CONSTANT-FIELD AND FARADAY EFFECTS; CONSTRUCTIONAL CONCLUSIONS

J.R. MÖSE

Hygiene Institute at Graz University, **Universitätsplatz 4, AUSTRIA.**

SUMMARY - It is by no means enough to keep conventional climatic factors, such as temperature of the air, humidity and heat radiation, constant to obtain indoor conditions fulfilling the highest demands of health. According to knowledge recently gained, static factors must also be taken into account to provide a healthy environment indoors.

Changes of the natural constant field conditions are to be found in solidly constructed enclosed buildings.

The favourable physiological effects of the undisturbed electrostatic constant field have been established with the help of comprehensive series of tests on laboratory animals exposed to the following conditions: I) Test area with positively poled homogeneous electrostatic constant field

This environment, corresponding to undisturbed atmospheric conditions, led to a heightening of vital activity (motility, consumption of feed and drinking water) an increase in the consumption of oxygen by the liver and of succinic and in glutamic dehydrogenase in liver mitochondria and a rise in the formation of antibodies.

2) Test area with Faraday effect.

The bioclimatical environmental conditions here are partly the same as those found in enclosed buildings of massive construction, particularly those with steel reinforcements. All the previously mentioned physiological parameters were extremely depressed or reduced. The paucity or lack of antibody production was particularly noticeable.

3) Test was under the usual environmental conditions of a laboratory without airconditioning.

The Parameters reached figures which were between the results obtained in the constant field of the Faraday area.

Practical conclusions with regard to the method of construction or the creation of artificial static conditions which are best for promoting good health may be drawn from these findings.

METHODOLOGIE DE LA RECHERCHE EXPERIMENTALE ET EPIDEMIOLOGIQUE DES DIVERS FACTEURS PHYSIOPATHOLOGIQUES DE L'ENVIRONNEMENT.

MAURICE STUPFEL

Groupe de recherche U.123, I.N.S.E.R.M.
Mécanismes physiopathologiques des nuisances de l'environnement
I.N.S.E.R.M., 3, rue Léon-Bonnat, Paris 16e, France

RESUME - La multiplicité des facteurs de l'environnement et la diversité de leurs points d'impacts sur l'état existentiel et évolutif des êtres vivants ne doit pas faire négliger les principes physiques, chimiques, biologiques et statistiques dont l'application synthétique constitue les bases d'une méthodologie. Il s'agit d'une approche pluridisciplinaire dont on ne saurait minimiser la complexité.

La difficulté de la mise en évidence des facteurs nocifs de l'environnement résulte de leur grand nombre et de l'adaptabilité remarquable de l'Homme. Eu égard à la rareté des observations fortuites faites chez l'homme lors d'intoxications professionnelles ou dramatiques (Minamata), force est de recourir à l'expérimentation animale qui fournit un modèle bien imparfait du fait des variations métaboliques entre espèces, ou à des enquêtes épidémiologiques où il est très difficile d'individualiser les facteurs.

On peut définir des objectifs à court terme (toxicité aiguë, mortalité et morbidité) et à long terme (pénétration dans l'organisme des substances chimiques, des vibrations, des ondes physiques, modification de perméabilités membranaires, organes cibles, excrétion, détoxification, accumulation, adaptation, sensibilisation, conséquences génétiques).

L'accroîssement astronomique du coût de la consommation médicale qui résulte du vieillissement des populations et d'une meilleure éducation du public doit inciter à des dépenses pour évaluer les risques nouveaux qui accompagnent les progrès techniques et l'apparition sur le marché de nouveaux produits industriels ou médicamenteux. Les accidents consécutifs à la thalidomide en sont un exemple.

Dès maintenant, une méthodologie applicable à une recherche expérimentale et épidémiologique des facteurs nocifs de l'environnement peut être envisagée, à condition qu'une planification, une standardisation des techniques et une confrontation internationale des résultats permettent une comparaison évaluative des données obtenues dans divers laboratoires et évitent la répétition de résultats incomplets, hâtifs et trop souvent apparemment contradictoires.

METHODOLOGY OF EXPERIMENTAL AND EPIDEMIOLOGICAL RESEARCH ON VARIOUS PHYSIOPATHOLOGICAL ENVIRONMENTAL FACTORS

MAURICE STUPFEL

Mécanismes physiopathologiques des nuisances de l'environnement
I.N.S.E.R.M., 3 rue Léon-Bonnat, Paris 16e.

ABSTRACT - The multiplicity of environmental factors and the diversity of their points of impact on the existing and evolutional state of living organisms should not lead one to neglect the physical, chemical, biological and statistical principles which together form the basis of a methodology. The approach is multidisciplinary and its complexity should not be underestimated.

The difficulty in demonstrating the presence of harmful factors in the environment stems from their great number and man's remarkable adaptability, In view of the rarity of chance observations in man, made on the occasion of occupational poisonings or dramatic poisoning cases e.g. (Minamata disease), it is necessary to resert to animal experiments, which provide a very imperfect model because of metabolic variations between species, or to epidemiological studies, in which it is very difficult to isolate individual factors.

One can define short-term research objectives (acute toxicity, mortality and morbidity) and long-term objectives (penetration of the organisms by chemical substances, vibrations and physical waves; changes in membrane permeability, target organs, excretion, detoxication, accumulation, adaptation, sensitization, genetic effects.)

The astronomical rise in medical costs resulting from the aging of populations and the improvement of public education should encourage investment in research to assess the new risks accompanying technical progress and the marketing of new industrial products and medicines. The toward consequences of the use of thalidomide are a case in point.

Starting now, a methodology applicable to experimental and epidemiological research on harmful environmental factors can be envisaged, provided that there is planning, standardization of techniques and an exchange of results at the international level, permitting the evaluation and comparison of data obtained in different laboratories, and avioding the repetition of incomplete results, hastily arrived at, and too often apparently contradictory.

UTILISATION DE CULTURES DE TISSUS HUMAINS POUR LA RECHERCHE D'UNE EVENTUELLE SYNERGIE ENTRE LES EFFETS TOXIQUES DE DEUX SOLVANTS USUELS : LE TOLUENE ET LE BENZENE

D. GRADISKI, J.L. MAGADUR

INRS, institut national de recherche et de sécurité
pour la prévention des accidents du travail
et des maladies professionnelles
route de Neufchâteau, 54500 Vandoeuvre - France

RESUME - L'évaluation quantifiée du pouvoir toxique d'une substance pour l'homme est une opération rarement réalisable. Il est donc habituel de traiter le problème sur animal de laboratoire et d'extrapoler les résultats à l'homme.

La recherche d'interférences entre les effets toxiques de deux substances nécessite le traitement statistique d'un grand nombre de valeurs obtenues sur plusieurs manipulations effectuées en parallèle. Peu de laboratoires disposent actuellement de moyens matériels nécessaires.

Il est proposé ici une technique utilisant des cultures de tissus avec un mélange benzène-toluène. Cette technique présente les avantages suivants:

- elle est peu dispendieuse,
- le matériel biologique est d'origine humaine,
- il est possible de travailler sur des grands nombres.

1°) Evaluation de l'action sur les cellules

a) détermination du pourcentage d'inhibition

Le pourcentage d'inhibition de croissance, à un moment donné est le rapport

$$\frac{(E - e) \times 100}{E},$$

E étant l'effectif moyen des cultures témoins,
e l'effectif moyen des cultures traitées.

b) détermination de la Dose Inhibitrice 50 (I.D. 50)

C'est la dose qui, au troisième jour de culture (fin de croissance exponentielle) produit une inhibition de croissance de 50%.

c) index mitotique

Il correspond à l'évaluation de la fraction de la population en prolifération active.

./.

2°) Recherche d'une interférence dans les actions toxiques

Il est effectué une comparaison statistique en analyse de variance, d'un témoin et d'un certain nombre de combinaisons de doses des deux toxiques étudiés (plan factoriel a^2).

3°) Conclusions$

L'analyse statistique comme les diagrammes à trois dimensions que l'on peut tirer de l'expérimentation sur cellules HELA, semblent montrer, à ce jour, pour le mélange benzène-toluène:

- une action polyphasique à très faible dose, en ce qui concerne le benzène seul,
- une potentialisation, en particulier aux faibles proportions de benzène (1 % dans le toluène).

USE OF HUMAN TISSUE CULTURES IN RESEARCH INTO POSSIBLE SYNERGISM BETWEEN THE TOXIC EFFECTS OF TWO COMMON SOLVENTS: TOLUENE AND BENZENE

J. L. MAGADUR and D. GRADISKI

Institut National de Recherche et de Sécurité pour la Prévention
des Accidents du Travail et des Maladies Professionnelles
VANDOEUVRE - FRANCE

ABSTRACT - It is rarely possible to evaluate quantitatively the toxic effects of a substance on man. It is therefore usual to deal with the problem by experimentation on animals in the laboratory and extrapolation of the results for man.

Research on the interaction of the toxic effects of two substances involves the statistical analysis of a large number of values obtained from several parallel experiments. Few laboratories have the necessary material means at the moment. This work proposes a technique using tissue cultures in a benzene-toluene mixture. This technique has the following advantages:

- it is very economical,
- the biological material is human in origin,
- it is possible to work on large numbers.

1.) Evaluating effects on cells

a) determining percentage inhibition

The percentage growth inhibition, at any given moment, is shown by the formula

$$\frac{(E - e) \times 100}{E}$$

E being the average number of control cultures,
e the average number of treated cultures.

b) determining the Inhibiting Dose 50 (I.D. 50)

This is the dose which produces a growth inhibition of

./.

50% on the third day of the culture (end of exponential growth)

c) Mitotic index

This corresponds to the evaluation of the fraction of the population in active proliferation.

2.) Research on toxic interactions

A statistical comparison was carried out using variance analysis, with a control subject and a certain number of combinations of doses of the two poisons studied (factorial plan a^2).

3.) Conclusions

Like the three-dimensional diagram which can be drawn from the experiments on HELA cells, the statistical analysis to date seems to show for the benzene-toluene mixture:

- as regards benzene alone, polyphasic action with a very weak dose,
- potentiation, especially with weak proportions of benzene (1% in toluene).

EXPOSURE OF LABORATORY ANIMALS TO URBAN AIR POLLUTION: PHYSICAL PLANT EXPERIMENTAL DIFFICULTIES OBSERVED EFFECTS

ANDREW L. REEVES, THOMAS F. MOONEY Jr., RALPH G. SMITH

Department of Occupational and Environmental Health
Wayne State University, Detroit, Michigan, USA

ABSTRACT - Approximately 3500 animals were involved in a 5-year experiment to determine the health effects of air pollution as it occurs in the center of a large city (Detroit). One-half of the animals breathed air from out-of-door constantly, with the air delivered to them into chambers with as little change as possible except temperature control. The other half of the animals breathed air after passage through activated charcoal and fine pore filter banks. Elimination of various pollutants ranged from excellent (particulate matter, oxidants) through fair (hydrocarbons, SO_2) to poor (NO_x, CO). Several strains of mice, rats, rabbits, and guinea pigs were exposed and studied during their lifetimes, in some cases including breeding and observation of progeny.

Mortality, morbidity, body temperature, weight gain, the results of periodic blood tests including hemoglobin, hematocrit, and red blood cell count. and starch gel zymograms of esterase, lactate dehydrogenase, and acid phosphatase of pulmonary and lymphnode tissues showed no significant differences between the colonies. Histopathologic studies on various tissues were also unremarkable except for the amount of particulate matter present in the lungs. Possible effects of borderline significance included elevated plasma alkaline phosphatase in exposed rabbits and increased spontaneous activity (by running wheels) in young exposed mice. The only pronounced and sustained difference between the colonies was in the white blood cell count, attributable chiefly to an increase in the number of lymphocytes in the exposed animals.

EFFETS SYNERGIQUES DES POLLUANTS PARTICULAIRES ET D'INFECTIONS EXPERIMENTALES TUBERCULEUSE OU ORNITHOSIQUE

J.C. MARTIN, L. LE BOUFFANT, H. DANIEL

CERCHAR - 60550 Verneuil-en-Halatte, France

RESUME - Divers types de modèles expérimentaux sont réalisés comportant des empoussiérages par voie aérienne associés à des infections de natures diverses.

Les empoussièrages sont effectués dans des cages à régulation automatique type CERCHAR et comportent l'inhalation de particules inertes (charbon) ou plus nocives (mélane charbon-quartz à divers pourcentages de quartz). Les charges pulmonaires variables sont obtenues en modulant la durée totale de l'empoussiérage.

Les contaminations bactériennes sont réalisées, soit par voie intraveineuse pour l'infection tuberculeuse (Mycobactérium Kansasii) soit par voie intrapériténoale ou par aérosols pour l'ornithose et le virus de la grippe.

Les résultats obtenus montrent l'existence de relations entre, d'une part la gravité de l'infection jugée sur des critères anatomiques et bactériologiques, et d'autre part:

- la nature de l'agent infectant et la voie d'inoculation utilisée
- la nature et la nocivité propre de chaque poussière
- la quantité de particules retenues dans les poumons
- la chronologie de la contamination bactérienne par rapport à celle de l'empoussiérage

Les mécanismes primaires responsables des phénomènes d'agravation n'apparaissent pas univoques. Ils sont liés au point d'impact particulier et au mode de multiplication spécifique de chaque agent infectant. Ils conditionnent le type de réaction et les effets synergiques constatés avec différents types d'infection survenant sur le poumon empoussiéré.

L'ensemble des résultats obtenus montre que le dépôt de polluants particulaires dans le parenchyme pulmonaire a pour effet de fragiliser le poumon vis-à-vis de certaines affections bactériennes, et notamment de la tuberculose. Cette fragilité apparaît comme d'autant plus marquée que la charge en polluant est plus élevée et que l'agressivité cellulaire des particules est plus forte.

LES EFFETS DES POLLUANTS SUR L'EPURATION PULMONAIRE

L. LE BOUFFANT, H. DANIEL, J.C. MARTIN, J.P. HENIN

CERCHAR - 60550 Verneuil-en-Halatte, France

RESUME - Dans une atmosphère polluée, il existe divers facteurs d'agression pulmonaire: particules solides, gaz irritants, microorganismes. Les facteurs peuvent agir séparément ou en synergie. Dans ce travail, sont examinés uniquement les effets des poussières et des gaz.

L'épuration pulmonaire des poussières a été mesurée par deux méthodes: d'une part, par inhalation des particules, sacrifice ultérieur des animaux par lots en fonction du temps et dosage des poussières dans les poumons, ce qui permet de tracer la courbe de l'épuration et d'en déterminer la vitesse; d'autre part, en utilisant une poussière marquée et en effectuant des comptages externes de la radioactivité intra-pulmonaire.

On a ainsi étudié:

- les variations de la vitesse d'épuration suivant l'espèce animale considérée et suivant la nature de la poussière inhalée,
- la dispersion individuelle au sein d'une même espèce,
- les modifications introduites par des dépôts préexistants de poussières, cytotoxiques ou non, sur la capacité d'épuration,
- l'influence des gaz irritants.

Des essais effectués sur l'animal, il résulte qu'il existe des différences importantes dans la vitesse d'épuration selon la nature de la poussière et selon l'espèce animale considérée. La différence est peu apparente au niveau de l'épuration bronchique qui s'avère dans tous les cas très rapide. Par contre, les vitesses d'épuration alvéolaire varient dans un rapport de l'ordre de 20 à 30 fois selon l'espèce, l'épuration étant très rapide chez le chat et très lente chez l'homme. On constate en outre, une variation individuelle importante au sein d'une même espèce.

La capacité d'épuration pulmonaire est nettement affectée par des inhalations antérieures de poussières, qui ont pour effet de ralentir le phénomène, d'autant plus fortement que la charge coniotique pulmonaire est plus élevée.

Les gaz irritants tels que SO_2, NO_2, l'acroléine exercent une action cytotoxique sur les macrophages alvéolaires. Cependant, in vivo, cette action ne semble pas modifier d'une façon importante la vitesse d'épuration.

Ces observations ont conduit à entreprendre des mesures de rétention et de capacité d'épuration chez l'homme. La méthode de mesure, applicable en clinique humaine, consiste à utiliser l'hématite marquée à des doses faibles (inférieures à I microcurie) et à effectuer des comptages

./.

externes comme pour l'expérimentation animale.

Les résultats montrent que la rétention et l'épuration varient dans de larges proportions d'un individu à l'autre. On retrouve les phases rapide et lente observées chez l'animal, la période longue pouvant dépasser 500 jours chez certains individus. La dispersion individuelle peut constituer un élément d'explication des différences de sensibilité à la pneumoconiose observée chez des sujets exposés au même risque.

Cette mesure peut constituer un moyen d'apprécier le risque que présente pour un individu l'exposition à des polluants particulaires déterminés.

THE EFFECTS OF POLLUTANTS ON PULMONARY CLEARANCE

L. Le BOUFFANT, H. DANIEL, J.C. MARTIN, J.P. HENIN

Cerchar - 60550 Verneuil-en-Halatte, France

ABSTRACT - In a polluted atmosphere there are various factors which attack the lungs: solid particles, irritant gases, microorganisms. These factors may act separately or synergistically. The present paper is concerned solely with the effects of dusts and gases.

Clearance of dust from the lungs was measured by two methods. In the first, particles were inhaled and groups of animals later killed at different times, after which the quantity of dust in the lungs was determined. From this it was possible to draw a clearance curve and determine the rate of clearance. In the second a labelled dust was used and the radioactivity in the lungs was determined by external counts.

The following were studied with the methods described :

- variations in the rate of clearance in different animal species and according to the nature of the dust;
- differences between individuals of the same species;
- the effects of preexisting deposits of dust, cytotoxic or non-cytotoxic, on clearance capacity;
- the effect of irritant gases.

From the animal tests it was apparent that there were considerable differences in the rate of clearance, depending on the nature of the dust and the animal species under consideration. The difference was hardly apparent in the case of clearance at the bronchial level, which was very rapid in all instances, In contrast, alveolar clearance rates varied by a factor of the order of 20 - 30 from species to species, clearance being very rapid in the cat and very slow in man. There was also considerable variation from individual to individual within the same species. The clearance capacity of the lungs was markedly affected by prior inhalation of dusts, which had the effect of slowing the clearance, particularly when larger amounts of dust were present.

Irritant gases such as SO_2, NO_2, and acrolein are cytotoxic to alveolar macrophages. In vivo, however, this appeared to have no great effect on the clearance rate.

These observations led us to measure retention and clearance capacity in man. The method of measurement, applicable to clinical work, uses labelled haematite at very low doses (below 1 microcurie), with external counts as in the animal tests.

.../...

The results show that retention and clearance vary considerably from individual to individual. There are rapid and slow phases, as observed in animals, the long period sometimes exceeding 500 days in certain individuals. Differences between individuals may partly explain the differences in susceptibility to pneumoniocosis observed in subjects exposed to the same risk.

This method of measurement may offer a means of assessing the risk to a particular individual from exposure to specified particulate pollutants.

EXEMPLE DE RECHERCHE DANS UNE ATMOSPHERE D'UNE SUBSTANCE CHIMIQUE CAUSE D'EFFETS PATHOLOGIQUES

A. CICOLELLA, D. GRADISKI, J.L. MAGADUR, B. MONCELON

INRS, institut national de recherche et de sécurité
pour la prévention des accidents du travail
et des maladies professionnelles
route de Neufchâteau, 54500 Vandoeuvre - France

RESUME - La recherche présentée ici met en évidence quatre points importants:

- la nécessaire collaboration entre médecins et laboratoires de recherche,
- le rôle d'équipes spécialisées dans le prélèvement et l'analyse des atmosphères,
- l'utilité du recours à l'expérimentation animale et à l'exploration biochimique raisonnée,
- la nécessité d'un traitement statistique des données acquises.

1°) Exposé des cas pathologiques observés:

Des médecins du travail détectent au sein de leur entreprise un nombre anormalement élevé d'inversions de formules sanguines, sans pouvoir les rattacher à une cause précise. Une Caisse d'Assurance Maladie est alertée et demande au Centre de Recherche de l'I.N.R.S. - NANCY d'étudier le problème.

2°) Intervention des équipes spécialisées dans le prélèvement et l'analyse des atmosphères d'ambiance industrielle.

Ces équipes ne détectent aucune des substances habituellement à l'origine de ce type d'anomalies.

Un inventaire soigneux des corps chimiques présents est dressé. L'un des corps (l'α-phénylindole) paraît suspect. Son étude est confiée au laboratoire de Toxicologie industrielle expérimentale de l'I.N.R.S.

3°) Expérimentation animale

L'α-phénylindole est administré par inhalation chez le lapin et par voies intrapéritonéale et orale chez la souris et le rat. Il a été effectué des examens pharmacologiques, hématologiques, anatomopathologiques, cytotoxiques et biochimiques.

L'exploration rapide de l'action de l'α-phénylindole sur le métabolisme des substances indoliques naturelles a donné les indications suivantes:

perturbation du métabolisme du tryptophane, avec élimination

./.

urinaire d'acide hippurique, de 5-hydroxy-indoles, dont parfois de la sérotonine.
L'explication de ces faits n'est pas encore acquise.

4°) Retour à l'observation sur l'homme, accompagnée de traitements statistiques

L'expérimentation animale ayant établi la corrélation entre l'administration d'α-phénylindole et la sortie urinaire des métabolites précités, ceux-ci ont été recherchés systématiquement sur un échantillon d'environ 500 travailleurs, exposés ou non, avant ou après exposition. Ces analyses ont établi, chez l'homme, la même réaction que chez l'animal.

La mise en oeuvre de ce dispositif, appliqué à l'évaluation des effets constatés sur la santé à la suite d'une exposition à un polluant présent dans l'environnement des lieux de travail, présente l'intérêt d'être progressive dans l'utilisation des moyens et de pouvoir être stoppée à la fin de chaque étape, si les résultats sont jugés satisfaisants.

EXAMPLE OF ATMOSPHERIC RESEARCH ON A CHEMICAL SUBSTANCE GIVING RISE TO PATHOLOGICAL EFFECTS

A. CICOLELLA, D. GRADISKI, J.L. MAGADUR, B. MONCELON

National Safety and Research Institute for the
Prevention of Industrial Accidents and Occupational Diseases
route de Neufchâteau, 54500 Vandoeuvre - France

SUMMARY - Four important points emerge from the research discussed in this paper:

- the necessity of collaboration between doctors and research laboratories,
- the role of specialist teams in sampling and analysing the atmosphere,
- the usefulness of experiments on animals and reasoned biochemical examinations,
- the necessity for a statistical analysis of the data obtained.

1.) Observed pathological cases reported:

Works doctors detected in the employees of their firm an abnormally high number of blood count inversions, but could not pin these down to any definite cause. A Health Insurance Fund was notified and asked the Research Centre of the I.N.R.S. at Nancy to study the problem.

2.) Action taken by teams specialising in sampling and analysis of the atmosphere of industrial environments:

These teams detected none of the substances which usually cause this type of anomaly.

A careful inventory was drawn up of chemical substances present. One of these (α-phenylindole) appeared suspect. The experimental industrial toxicology laboratory of the I.N.R.S. was asked to study this substance.

3.) Experiments conducted on animals:

The α-phenylindole was administered to the rabbit by inhalation. It was fed orally to mice and rats and also injected into the peritoneum. Pharmacological, hematological, anatomico-pathological, cytotoxic and biochemical examinations were carried out.

Prompt examination of the action of α-phenylindole on the metabolism of the naturally-occurring indole derivatives gave the following results:

Disturbance of the tryptophane metabolism, with urinary elimination of hippuric acid and 5-hydroxy-indoles, including sometimes serotonin.

These facts have not yet been explained.

4.) Return to observations on man, with statistical analysis:

Experiments on animals having established a correlation between the administration of α-phenylindole and the urinary evacuation of the above-mentioned metabolites, systematic research was carried out on these metabolites in a sample of approximately 500

./.

workers, some exposed and others not, before or after exposure. These analyses showed the same reaction in man as in animals.

The use of this scheme as applied to the evaluation of observed effects on health of exposure to a pollutant present in the work environment, is of importance in that it is progressive in the means used and in the fact that the procedure can be halted at the end of any stage if the results are considered satisfactory.

ASPECTS OF POLLUTION IN THREE URBAN CENTRE SITUATIONS IN GREAT BRITAIN

R. G. DERWENT, J. S. S. REAY AND H. N. M. STEWART

Warren Spring Laboratory, Stevenage, Hertfordshire, U.K.

ABSTRACT - Continuous measurements of most common air pollutants are being made at the side of a busy street in London with parallel measurements at a background site near the centre of the urban area. Other continuous measurements of concentrations of a limited range of pollutants are being made at busy street-side locations in Glasgow and at Cardiff. This surveillance activity, which is part of the central government supported environmental programme will shortly be extended to include sites in Birmingham and Cambridge.

The pollutant measurements are supplemented by measurements of traffic-flow and wind speed and direction. Supplementary measurements of sunlight intensity and of visibility are also made at the background site. Gaseous pollutants which include carbon monoxide, total hydrocarbons (supplemented by some measurements of methane, acetylene and ethylene), nitric oxide, nitrogen dioxide, sulphur dioxide and ozone are measured by gas phase physical-chemical methods, e.g. chemiluminescent reactions, flame photometry etc. Particulates, including suspended lead, are measured by sequential sampling with off-line non-destructive manual methods.

Data for gaseous pollutants, traffic flow and wind speed and direction are logged on punched paper tape and processed in batches on an ICL 1903 computer.

The paper describes the objectives of the survey. The selection of equipment and siting are discussed, with particular reference to requirements for an overview of the general situation in city centres within the country for public health protection assessment.

The paper gives details of the levels measured and is illustrated by selected cumulative frequency curves having points of interest. An analysis of the data for significant diurnal, seasonal and annual variations in pollutant levels has been made. The paper illustrates the significant correlation between pollutants themselves, between the pollutants and traffic flow and the modifying effect of wind speeds.

The evidence for evaluating the relative importance of fixed and vehicular sources in the situation studied will be presented for discussion. The production of ozone by photochemical reactions in the atmosphere has also been demonstrated. The meteorological factors controlling photochemical reactions in Great Britain are described and discussed.

ETUDE DE LA CONTAMINATION DE FOURRAGES ET LEGUMES PAR LE PLOMB ET LES METAUX LOURDS

*E. DELCARTE, *R. IMPENS, **R. KIRCHMANN ET *P. NANGNIOT

*Faculté des Sciences Agronomiques de l'Etat, Gembloux
**Centre d'Etudes de l'Energie Nucléaire, Mol, Belgique

RESUME - Les auteurs décrivent la méthode qu'ils appliquent dans l'étude de la contamination de l'environnement et de la chaîne alimentaire par les métaux lourds, et tout particulièrement par le plomb, le cadmium et le zinc.

Une première phase consiste à prélever en sites industriels et urbains, ainsi qu'à proximité des autoroutes, des échantillons de sol ainsi que certains végétaux très répandus dont Plantago major L. (plantain majeur), Ligustrum sp. (troène), Trifolium repens L. (trèfle rampant) et Tussilago farfara L. (tussilage). Les concentrations en éléments métalliques de ces échantillons sont déterminées par oscillopolarographie à tension imposée.

On délimite ainsi des zones à risques accrus où des prélèvements systématiques de fourrages, légumes et fruits sont faits tout au long de la période de végétation.

L'évolution et l'importance des retombées en Zn, Cd, Pb, Ni, Co et Cu sont suivies dans des potagers et vergers de la vallée mosane, à proximité d'usines traitant des minerais. Les résultats sont comparés à ceux obtenus dans la banlieue de Bruxelles, près d'échangeurs autoroutiers et en zone témoin, éloignée de toute source de pollution. Ces résultats font aparaître des risques importants d'intoxication chronique des hommes et animaux consommant les végétaux contaminés. Parallèlement, des essais portant sur l'absorption, la rétention et la toxicité de ces éléments métalliques chez les plantes, sont menés en laboratoire. Les résultats acquis, à l'aide de Pb stable et de ^{210}Pb chez Zea mays L. (maïs) sont discutés.

Enfin, des essais d'affouragement de vaches laitières à l'aide de fourrages artificiellement enrichis en Pb stable et ^{210}Pb sont en cours. Ils ont pour but de calculer le taux de transfert du Pb alimentaire dans le lait, les urines et les matières fécales.

La discussion des résultats fait apparaître les risques de contamination de la chaîne alimentaire.

RESEARCH INTO THE CONTAMINATION OF FODDER AND VEGETABLES BY LEAD AND HEAVY METALS

*E. DELCARTE, *R. IMPENS, **R. KIRCHMANN AND *P. NANGNIOT

* Faculté des Sciences Agronomiques de l'Etat, Gembloux
** Centre d'Etudes de l'Energie Nucléaire, Mol, Belgium

ABSTRACT - Description of the methods used by the authors for their study of contamination of the environment and of the food chain by heavy metals, with particular reference to lead, cadmium and zinc.

The first phase consists of taking samples, in industrial and urban areas and in the vicinity of motorways of soil and various common plants including Plantago major L. (greater plantain), Ligustrum sp. (privet), Trifolium repens L. (white clover) and Tussilago farfara L. (coltsfoot). Concentrations of metal substances in these samples are measured by means of oscillopolarography at a set voltage.

Risk areas are thus demarcated where fodder, vegetable and fruit samples are taken regularly throughout the vegetation period. A watch is kept on the progress and extent of Zn, Cd, Pb, Ni, Co and Cu fall-out in kitchen gardens and orchards in the vicinity of ore dressing works in the Meuse valley. The results are compared with those obtained in the suburbs of Brussels near motorway intersections and in a control area, away from any source of pollution. These results reveal that there is a serious risk of chronic poisoning in human beings and animals which feed on contaminated plants. Parallel laboratory tests are being carried out on the absorption , retention and toxicity of these metal substances in plants. The results obtained using stable lead and lead 210 in Zea mays L. (maize) are discussed.

Finally, dairy cattle are being experimentally fed on fodder which has been artificially enriched with stable lead and lead 210. The aim is to calculate the rate of alimentary lead transfer to the milk, urine and faeces.

Discussion of the results shows the risks of contamination of the food chain.

EFFECT OF SECONDARY LEAD SMELTERS ON AIR, SOIL AND VEGETATIONAL QUALITY, AND ON LOCAL RESIDENTS IN TORONTO

T. M. ROBERTS, T. C. HUTCHINSON, R. E. JERVIS, J. PACIGA,
A. CHATTOPADHYAY AND J. VAN LOON

Institute of Environmental Sciences and Engineering
and University of Toronto, Toronto, Canada

ABSTRACT - A joint interdisciplinary study involving health scientists, pediatric physicians, botanists, chemical engineers and chemical analysts has been made of the environmental contamination being caused by two lead recovery smelters located in residential areas of Toronto. The smelters have operated for approximately 60 years. In response to neighbourhood complaints and as part of a large ongoing heavy metal study, soils and vegetation in the vicinity of the smelters were initially screened for their lead content. Lead contents of the soil reached 100,000 ppm in surface soils close to one smelter, and exceeded 7,000 ppm in residential gardens at both of them. Foliage of naturally-occurring vegetation around the smelters was also analyzed and suggested an ongoing problem of lead contamination. High volume dust samplers and dustfall buckets were used for monitoring the concentration of airborne lead and the amount falling as dust. Suspended lead levels were relatively low but dustfall levels were very high, i.e. up to 1200mg/m^2/30 in a local garden. These levels of dustfall lead were a great deal higher than those found around secondary lead smelters in other parts of the world and suggested potential human health effects. Comparisons of lead uptake from the soil as opposed to that from the air into vegetables indicated significant crop contamination from the air. Freshly planted lawn grass at one location has been monitored at monthly intervals so that rates of lead input into the soil, the humus and the grass have been calculated. These indicate soil accumulation of up to 1500 ppm per year in surface soils. Blood lead analyses have been determined on residents in the area of both smelters and compared with blood lead levels of an urban control group selected as living in a similar type of housing, of similar age, upkeep of properties, etc. The control group merely lacked the secondary lead smelters. The data indicated significant effects on the local residents from the smelters. Some residents, notably children, have been hospitalized. Comparisons were made between hair lead levels and blood lead levels from individuals. Significant correlations were obtained. Particle size determinations for dustfall lead were made in the vicinity of the smelters and compared with that from automobiles. Lead-bromine ratios were also compared and all strongly indicated the smelters as an ongoing source of the problems. Techniques used for the analyses included atomic absorption and flameless atomic absorption spectrophotometry, neutron activation analyses and polarography. The usefulness of the techniques to the study will be also discussed.

SUI VANTAGGI PRESENTATI DALL'USO DELLA FORNACE A GRAFITE COME NUOVA TECNICA DI ASSORBIMENTO ATOMICO NELLA ANALISI DELL'INQUINAMENTO DELL'AMBIENTE DI LAVORO

DUILIO CASULA E GEROLAMO DEVOTO

Istituto di Medicina del Lavoro, Università degli Studi, Cagliari, Italia

---

RIASSUNTO - Alcuni elementi metallici (Piombo, Zinco, Antimonio, Cadmio, Rame, Argento, Arsenico, Nichel, Cobalto) presenti a livello di tracce in differenti ambienti di lavoro, sono stati analizzati, mediante l'uso della spettroscopia per assorbimento atomico, con le nuove tecniche che utilizzano il fornetto a grafite.

Vengono discusse le condizioni di lavoro, i risultati ottenuti ed i vantaggi presentati dalle nuove metodiche di prelievo e di dosaggio impiegate.

THE ADVANTAGES OF USING A GRAPHITE FURNACE AS A NEW METHOD OF ATOMIC ABSORPTION FOR ANALYSING POLLUTION IN THE WORKING ENVIRONMENT

DUILIO CASULA AND GEROLAMO DEVOTO

Institute of Industrial Medicine, University of Cagliari, Italy

ABSTRACT - Some metallic elements (lead, zinc, antimony, cadmium, copper, silver, arsenic, nickel, cobalt) of which traces are sometimes found in various types of working environment, were analysed by means of atomic absorption spectroscopy and new techniques based on the use of the graphite furnace.

The paper covers the working conditions, the results obtained and the advantages offered by the new methods of sampling and quantitative analysis which were used.

DISTRIBUTION OF LEAD CONCENTRATIONS IN URBAN ATMOSPHERE

A. ZDROJEWSKI, L. DUBOIS AND W. BRABANT

Air Pollution Control Directorate, Department of Environment, Canada

---

ABSTRACT - This work reports on lead concentrations observed at several locations in a Canadian city. The different locations show the variations in lead concentrations which occur in various dimensions.

The following locations were studied:

1. An underpass location on an autoroute where lead concentrations were measured over a period of one month at the 5-metre level.
2. One station in the centre of the city where measurements were made at three different vertical levels of 5, 10 and 15 metres over a period of two weeks.
3. Measurements made at seven separate stations at street level for one week.

The measurements referred to were made at different times over a period of one year. Some other lead results have been obtained by Hi Vol sampling separately from the measurements already mentioned.

A daily and weekly pattern in lead concentration, with respect to sampling time, has been observed. It is thus possible to know the lead concentrations that a person could be exposed to at different times of the day and at different locations in the city.

LIVELLI DI ALCUNI METALLI NELLA DIETA DI BAMBINI E DI ADULTI. CONSIDERAZIONI SUL LORO SIGNIFICATO

*M. ALLEGRINI, **G. GIANANI, *E. LANZOLA, *C. ROGGI, **G.C. SABATINI

*Istituto di Igiene, Università di Pavia, Pavia, Italia
** Ministero della Sanità, Roma, Italia

RIASSUNTO - Sono state eseguite misure di Cadmio, Cromo, Rame e Zinco in circa 60 campioni di vari prodotti alimentari per la prima infanzia presenti sul mercato in Italia, comprendenti latte in polvere, omogeneizzati, farine lattee e succhi di frutta.

Misure analoghe sono state effettuate in un pool di campioni alimentari costituenti il regime alimentare di una persona adulta media per una settimana.

Gli stessi metalli sono stati misurati anche in campioni a base di mais, manioca, riso, arachidi ed inoltre di fagioli, pomodori e spinaci provenienti da una regione africana (Dahomey), al fine di evidenziare differenze eventuali tra paesi a diverso sviluppo industriale. In base ai risultati ottenuti sono state calcolate le introduzioni medie giornaliere di Cadmio, Cromo, Rame e Zinco nei bambini e negli adulti.

Tali introduzioni sono state confrontate con i dati riportati dalla letteratura.

E' stato effettuato un esame critico sul duplice aspetto che taluni metalli possono presentare in nutrizione umana risultando nello stesso tempo oligoelementi fisiologicamente necessari e contaminanti ambientali. In alcuni casi, come per il Cadmio per il quale non è ancora chiara la funzione biologica della metallotioneina, appare difficile stabilire una soglia discriminante tra fabbisogno necessario e presenza indesiderata nell'alimento come contaminante.

LEVELS OF CERTAIN METALS IN THE DIET OF INFANTS AND ADULTS. DISCUSSION OF THEIR SIGNIFICANCE.

*M. ALLEGRINI, ** G. GIANANI, *E. LANZOLA, *C. ROGGI & G. C. SABATINI

*Istituto di Igiene, Università di Pavia, Pavia, Italy
** Ministero della Sanità, Roma, Italy

ABSTRACT - Cadmium, chromium, copper and zinc content were measured in some 60 samples of various baby food products on sale in Italy, including powdered milk, homogenised foods, dried milk feed and fruit juices.

The same measurements were made for a "basket" of foodstuffs samples comprising an average adult's normal diet for one week.

Content of the same metals was also measured in samples of foods based on maize, manioc, rice, ground nuts and also beans, tomatoes and spinaches from an African area (Dahomey), in order to detect any differences between countries in different stages of industrial development. On the basis of these results the average daily intakes of cadmium, chromium, copper and zinc by infants and adults were determined.

These intake figures were compared with literature data.

A critical investigation was made on the dual aspect which such metals can have in food consumed by human beings, since they constitute trace elements which are a physiological necessity and at the same time environmental contaminants. In some cases, e.g. cadmium, where the biological function of the metal content is still not clear, it appears difficult to determine a threshold value intermediate between the necessary minimum and an undesirable level of the metal in the food as a contaminant.

USE OF THE RADIOISOTOPES ^{32}P AND ^{35}S IN STUDIES ON THE BEHAVIOUR OF PESTICIDES IN THE SOIL

ZBIGNIEW SZPERLINSKI

Institute for Environmental Studies, Polytechnical University
Warsaw, Poland

ABSTRACT - Activated atoms were used to determine the possibility and extent of contamination of underground waters by pesticides used in agriculture. The sorption and dynamics of the migration of two organo-phosphorous pesticides, fenitrothion and malathion, were studied. These two products are currently being proposed as agricultural pesticides.

They would replace other substances of the chlorinated hydrocarbon group, including DDT, which are more dangerous to health, but are themselves source of potential contamination of underground waters.

Studies were carried out on different types of soil: sandy and clay. Isotherms were determined for the sorption of the pesticides examined, together with their distribution coefficients, Kd. The effects of pH values, exchangeable ions, organic substances (organic C and N) and the mechanical composition of the sorption of fenitrothion and malathion were studied.

DIE BELASTUNG DER NAHRUNG MIT DEN SCHWERMETALLEN BLEI, CADMIUM, QUECKSILBER, ZINN UND ARSEN IN OESTERREICH.

H. WOIDICH, W. PFANNHAUSER

Forschungsinstitut der Ernährungswirtschaft
1190 WIEN, XIX, Blaasstrasse 29, Oesterreich.

KURZFASSUNG - Gestützt auf eingehende eigene Untersuchungen wurde die Belastung verschiedenster Lebensmittel mit den Schwermetallen Blei, Cadmium, Quecksilber, Zinn und Arsen in Oesterreich ermittelt.

Umfangreiches statistisch ausgewertetes Material für besonders belastete Lebensmittel, insbesondere für Fisch, Muscheln und Innereien wird vorgelegt. Darüberhinaus werden repräsentative Untersuchungen anderer Lebensmittel angeführt.

Die höchsten Gehalte an Quecksilber fanden sich in Thunfischkonserven. Mit Cadmium waren Innereien und Muscheln, aber auch einige Cerealien stärker kontaminiert, während der Arsengehalt verschiedener Innereien, so zum Beispiel Dorschleber, bemerkenswert war. Bei den Untersuchungen von Arsen fiel auf, dass geräucherte Produkte geringfügige, jedoch signifikant erhöhte Gehalte gegenüber den ungeräucherten Produkten aufwiesen. Eine Kontamination während des Räucherprozesses ist deshalb nicht auszuschliessen. Die Hauptquelle der Belastung der Nahrung mit Zinn stellen in verzinnten Behältern konservierte Lebensmittel, insbesondere Gemüse und Obstkonserven dar.

Verhältnismässig hohe Gehalte an Zinn fanden wir in eingedosten Spargeln sowie Citrusfrüchten.

Die Entzinnung aufgrund von Komplexbildung mit organischen Fruchtsäuren wird erörtert.

Weiters gelangen auch zinnorganische Verbindungen, die vielfach als Spritzmittel Anwendung finden, in die Nahrung. Das toxikologische Risiko organischer Metallverbindungen ist beträchtlich.

Auf Basis der ermittelten Belastung der einzelnen Lebensmittel wird unter Hinzuziehung der statistisch erfassten Verzehrsgewohnheiten des Oesterreichers versucht, die derzeitige Aufnahme von Schwermetallen mit der Nahrung abzuschätzen.

Die festgestellten Belastungen werden mit internationalen Normen und Ergebnissen anderer Länder verglichen.

THE INCIDENCE OF THE HEAVY METALS LEAD, CADMIUM, MERCURY, TIN AND ARSENIC IN FOODSTUFFS AND FEEDSTUFFS IN AUSTRIA

H. WOIDICH AND W. PFANNHAUSER

Forschungsinstitut der Ernährungswirtschaft (Research Institute of the Food and Fodder Industry), Vienna, Austria

---

ABSTRACT.

The incidence of the heavy metals lead, cadmium, mercury, tin and arsenic in various foodstuffs in Austria was established and substantiated by thorough research by the Institute.

A large volume of statistics on foodstuffs with an especially high incidence, in particular, fish, shellfish and offal, is presented. In addition representative tests on other types of food are quoted.

The highest mercury contents were to be found in tinned tunny. Offal and shellfish were fairly strongly contaminated with cadmium, as were some cereals, whilst the arsenic content of various kinds of offal, cod liver for example, was noticeable. While investigating arsenic, it was noticed that smoked products had slightly, but significantly, higher contents compared to unsmoked products. Contamination during the smoking process should therefore not be excluded. The main source of tin in food is the tin-plated containers of canned products, in particular, tinned fruit and vegetables.

We found relatively high tin-contents in canned asparagus and citrus fruits. Detinning due to sequestering with organic fruit acids is discussed. Organic tin compounds, often used as sprays also get into food. The toxicological risk of organic metal compounds is considerable.

On the basis of the incidence in the various kinds of food which has been established, an attempt is made to estimate the present intake of heavy metals with food, taking into account the statistics on Austrian dietary habits.

The incidences established are compared with international standards and results obtained in other countries.

ASBESTOS IN THE CALIFORNIA ENVIRONMENT

J.J.WESOLOWSKI, R.STANLEY, G.SMITH, L.CARPENTER, A. BERNER

Air and Industrial Hygiene Laboratory,
State of California Department of Health, USA.

ABSTRACT - The California population is exposed to asbestos from natural sources such as wind and water erosion of asbestos-containing rock formations and from a multitude of anthropogenic sources. Of particular concern are such sources as asbestos mines and mills, automobile brake linings, asbestos spraying for fire proofing of buildings, asbestos cement pipes for transporting drinking water, talcum, and the widespread use of asbestos filters in the food, drug and beverage industries. Over the last 30 years the world's consumption of asbestos has increased from about 500,000 tons per year to about 4,000,000 tons per year.

Inhalation of asbestos fibers in sufficient quantity is associated with three diseases - asbestosis, lung cancer, and mesothelioma. Further, there is also a suspicion of a link between asbestos ingestion to gastrointestinal cancer. Thus it is important that monitoring programs be established to help assess the health effects of this pollutant. Since the mechanism of pathogenicity may be dependent on the size of the fibers, it is important that any monitoring scheme include size distribution as well as identification and counting techniques. Since most of the particles of asbestos found in environmental media are too small to be counted by the optical microscope, electron microscopy must be used. This paper will discuss the sampling methodology and the electron microscopic techniques used to identify, count, and size asbestos particles in California environmental media.

SITING CONSIDERATIONS FOR AIR QUALITY MONITORS AS APPLIED TO EPIDEMIOLOGICAL STUDIES

P. R. HARRISON

North Clark Street, Chicago, Illinois, USA

ABSTRACT - Every honest researcher has the insecurity, if ever so slight, that his obvious conclusions may be biased by his measurement technique or the environments in which the tests were conducted. A difficulty the psychologist and pollsters have always had is "are we measuring what we think we are measuring?" The same is true for any environmental monitoring for any purposes.

There are three factors in any of the environmental investigations. Those factors entail the inner-relationships between the emission, the transport and the effect or exposure on the object or organism in question. Thus, in any assessment of effect of any environmental assault one must consider the characteristics of the emission and the effect of its transport media before arriving at the receptor. This is especially true in real world or "ambient" monitoring situations. Even in the laboratories, special care must be used to eliminate such factors as wall deposition, deterioration or enhancement by other synergistic materials present within test chambers. These, of course, can be controlled.

Epidemiological Studies using air monitoring data, especially those data provided by persons whose monitoring purposes are other than epidemiological, usually are accepted on face value. It can be shown that the ambient air quality is very sensitive to the placement of the sensor, both in the horizontal and vertical and with respect to the emission source. Thus, correlations of this data with respect to health effects can become overly biased in either direction, according to this placement. Each of the six currently important pollutants in the United States are discussed with respect to these siting considerations and their relationship between sources and the ultimate receptor exposure. It is implied that many of the statistical techniques are superior to the data to which the calculations are applied.

This paper presents some simple rules for siting in air quality monitors with respect to the pollutant and its source. It is suggested that prespective air quality data be investigated to assure that the data is not overly sensitive to the sensor location.

VALUTAZIONE DI UN INDICE RAPIDO DI CONTAMINAZIONE DA FUMO DI TABACCO DEGLI AMBIENTI CONFINATI E STUDIO DELLA COMPOSIZIONE SIA DELLA PORZIONE ASPIRATA CHE DI QUELLA AMBIENTALE DEL FUMO DI SIGARETTA

G. SCASSELLATI SFORZOLINO, A. SAVINO
Istituto d'Igiene dell'Università degli Studi di Perugia, Italia

RIASSUNTO - E' stata studiata la composizione del fumo di sigaretta sia della porzione aspirata dal fumatore che di quella che si disperde nell'ambiente durante i periodi di non aspirazione, facendo fumare le sigarette in un'apparecchiatura automatica che riproduce il fumare umano e che permette di raccogliere separatamente le due porzioni del fumo. In queste sono stati dosati i componenti sia della fase gassosa che di quella corpuscolata, e cioè: ossido di carbonio, anidride carbonica, ossidi di azoto, ammoniaca, aldeidi, nicotina, catrame totale, I.A.P. Si è anche messo a punto un indice di valutazione rapida della contaminazione da fumo di tabacco degli ambienti confinati.

EVALUATION OF A RAPID INDEX OF ENVIRONMENTAL POLLUTION BY TOBACCO SMOKE AND STUDY OF THE COMPOSITION OF THE MAIN-STREAM AND SIDE-STREAM CIGARETTE SMOKE

G. SCASSELLATI SFORZOLINI, A. SAVINO

Institute of Hygiene, University of Perugia, Perugia - Italy

ABSTRACT- A study has been made of the composition of cigarette smoke, viz, of the portion inhaled by smokers and that dispersed into the atmosphere during periods of non-inhalation; special automatic equipment was used to reproduce the effect of smoking, the two different portions of smoke being collected separately. The gaseous and corpuscular components of both types of smoke were analysed quantitatively for carbon monoxide, carbon dioxide, oxides of nitrogen, ammonia, aldehydes, nicotine, total tars, and P.A.H. A rapid method of analysis was also developed for tobacco smoke contamination in enclosed environments.

BEEINFLUSSUNG DES KOHLENMONOXIDSPIEGELS DURCH LUEFTUNGSTECHNISCHE ANLAGEN.

H. RUEDEN, K. BOTZENHART, H. LANGER

Hygiene-Institut der Universität, 53 Bonn 1, Venusberg-Klinikgelände, B R D

KURZFASSUNG - Zahlreiche Messungen in verkehrsreichen Strassen haben CO-Konzentrationen gezeigt, welche die Grenze der Gesundheitsgefährdung erreichen, wenn nicht gar überschreiten.

In diesem Zusammenhang erhebt sich die Frage, welche CO-Konzentrationen in den Innenräumen der anliegenden Gebäude auftreten, in denen sich zeitweise oder dauernd Personen aufhalten.

Es werden daher die Konzentrationen gemessen, welche in der Aussenluft und in der Innenluft von Gebäuden vorliegen, die sich in immissionsbelasteten Gebieten befinden.

Ferner wird der Frage nachgegangen, ob lüftungstechnische Anlagen den Gehalt der Raumluft an CO signifikant beeinflussen. Hierzu werden Messungen in teil- und vollklimatisierten Gebäuden vorgenommen. Möglich sind Erhöhungen infolge vermehrter Nachlieferung oder aber Erniedrigungen der CO-Konzentration infolge von Abscheidung in den Klimaaggregaten oder Ansaugung schadgasarmer, sauberer Luft.

Die Auswirkungen medizinisch begründeter Forderungen zur Vermeidung von Beeinträchtigungen der Gesundheit auf die technische Gestaltung von lüftungstechnischen Anlagen werden anhand von Beispielen und Messwerten erläutert.

EFFECTS ON THE CARBON MONOXIDE LEVEL OF AIR-CONDITIONING PLANTS

H. RUEDEN, K. BOTZENHART, H. LANGER

Hygiene-Institut der Universität
53 Bonn 1, Venusberg-Klinikgelände - Germany

ABSTRACT - Numerous measurements taken in streets carrying heavy traffic have shown CO-concentrations equal to or even in excess of the level which represents a danger to health.

In this connection, the question arises as to what CO-concentrations occur inside the adjacent buildings in which people are present for short or long periods.

The concentrations in the air both inside and outside buildings in areas subjected to these high emission levels are therefore measured.

The question of whether air conditioning plants have any significant effect on the CO content of the air is also investigated. Measurements are taken in partly and fully air-conditioned buildings. The possibilities are that increased CO levels occur owing to the increased delay in the delivery of air into the buildings, or that the CO is less concentrated as a result of precipitation in the air-conditioning plants or because cleaner air containing a smaller volume of harmful gas is drawn in by the plant.

The results of demands (which are well-founded medically) that effects harmful to health should be eliminated in the design of air-conditiong plants are explained with the help of examples and experimental data.

RECAPITULATION OF EXPOSURES AROUND A POINT SOURCE OF AIR POLLUTION

MARVIN B. HERTZ

Technical Center, EPA, Research Triangle Park, N.C., USA

ABSTRACT - The Salt Lake Valley in the western United States offers a unique setting for observing relationships between the health parameters of the Community Health and Environmental Surveillance System (CHESS) and a gradient of human exposure to sulfur dioxide. Four communities in or near the Valley were selected to represent an exposure gradient to sulfur dioxide, emitted primarily from a large copper smelter. It was expected that the levels of other pollutants would be below the National Ambient Air Quality Standards and the concentrations of suspended particulates would be similar in the four communities.

Magna, Kearns, Salt Lake City and Ogden, the study communities, all in the state of Utah, are located approximately 5, 8, 13 and 35 miles from the smelter respectively.

Air monitoring sites were located approximately in the center of each study population. Total suspended particulates and their sulfate and nitrate fractions were monitored daily in addition to sulfur dioxide and nitrogen dioxide. Monthly dustfall and dustfall trace metal concentrations were measured. Tape samplers provided continuous 2-hour measurements of particulate matter.

Monthly arithmetic mean sulfur dioxide and suspended sulfate concentrations showed that Magna had highest levels with Kearns, Salt Lake City and Ogden following in that order. Although Salt Lake City, Ogden and Kearns had similar average sulfur dioxide levels, Kearns had considerably higher peak values; however, peak values for Kearns were considerably lower than those for Magna. A month-long smelter strike was reflected in extremely low levels of both pollutants in Magna and Kearns.

The highest total suspended particulate and tape sampler particulate concentrations of Salt Lake City were followed by Ogden, Magna and Kearns in that order.

Nitrogen dioxide and suspended nitrates exhibited similar gradients. Salt Lake City received the highest exposures while Ogden recorded slightly lower levels. Kearns and Magna had similar but considerably lower concentrations than the other two communities.

No consistent gradient for dustfall or dustfall trace metals was evident.

Annual mean concentrations of total suspended particulate and nitrogen dioxide were below the National Ambient Air Quality Standards for all communities. Seasonal variations were evident for all pollutants; levels during summer months were much lower than during winter months.

Past sulfur dioxide exposure estimated from annual smelter emissions and currently measured levels indicate that past exposures were considerably higher (about 120 percent) than present levels.

RECAPITULATION OF METROPOLITIAN AIR POLLUTION EXPOSURES ARISING FROM MOBILE AND STATIONARY SOURCES

DAVID O. HINTON

EPA Human Studies Laboratory, Research Triangle Park, N.C. USA

ABSTRACT - Measurements of previous air pollution exposures and continuing air monitoring surveillance in a study community provides a basis for epidemiologic studies on the health effects of ambient pollution. Sulfur dioxide, total suspended particulate and dustfall measurements for the city of Chicago, Illinois, and for the Chicago-Northwest Indiana Metropolitan area have obtained in recent years. Based on these measured values, it was possible to estimate past pollutant exposure in these areas for the period 1950-1970.

Pollution sources include primarily power generating plants, residential and commercial sources, automobiles, and industrial sources without dominance from any one specific type of product. Pollution effluents are continually influenced by changing climatological conditions creating complex exposures to area residents.

Limited data were available during the earlier years of the 1950-1970 period. A consistent correlation was found to exist between dustfall and total suspended particulates, and dustfall and suspended sulfates. Total suspended particulate and suspended sulfate exposures were estimated using this relationship. Sulfur dioxide was not correlatable to dustfall in the Chicago area. However, data from a conductometric instrument provided exposure estimates for 1960-1970.

The exposure estimates indicate a definite pollution exposure gradient highest in east central Chicago and decreasing radially toward the city boundary. Exposure in the suburbs was generally lower than exposure within the city. In some instances, sulfur dioxide exposure in the suburbs equaled or exceeded the city exposure, possibly as a result of point sources. Low exposures for non-urban areas, attributed to fewer sources per unit area, were verified.

ZUM PROBLEM DES PASSIVRAUCHENS IM AUTO

H.P. HARKE

Forschungsinstitut der Zigarettenindustrie - Hamburg - B R D

KURZFASSUNG - In zunehmendem Masse wird der Einfluss des Tabakrauchens auf die Luftverunreinigung in geschlossenen Räumen diskutiert. Seit 1969 sind mehrere Arbeiten erschienen, in denen über die Messungen von Rauchinhaltsstoffen in Innenräumen in Abhängigkeit von der verrauchten Tabakmenge und der Lüftung berichtet wird. Erfasst wurden vor allem die toxikologisch besonders bedeutsamen Rauchinhaltsstoffe CO und Nikotin. Auch über Versuche zur Messung der Resorption dieser Verbindungen durch Nichtraucher wurde berichtet. Es fehlen bisher Untersuchungen der Verhältnisse im Kraftfahrzeug.

Daher haben wir unter definierten Bedingungen im Windkanal in einem europäischen Wagen der unteren Mittelklasse Messungen durchgeführt. Gemessen wurde kontinuierlich der CO-Gehalt im Inneren des Kraftfahrzeuges, das mit 3 Rauchern und einem Nichtraucher besetzt war. Die Windgeschwindigkeit wurde so eingestellt, dass die Geschwindigkeiten 0 und 50 km/h simuliert wurden. Bei dem Fahrzeug waren Fenster und Türen fest geschlossen, bei den einzelnen Untersuchungsserien waren die Lüftungsklappen geschlossen, geöffnet oder geöffnet bei laufendem Ventilator. Die Probanden rauchten im Verlauf einer Stunde immer zur gleichen Zeit jeder 3 Zigaretten oder in einer anderen Versuchsserie nacheinander je 2 Zigaretten. Durch die Versuchsbedingungen waren exogene Einflüsse durch die fahrzeugeigenen Abgasen und die Abgasen anderer Autos ausgeschaltet.

In Ergänzung dieser Untersuchungen haben wir in verschiedenen Autotypen den CO-Gehalt auf einer vorgegebenen Wegstrecke in Hamburg gemessen. Auch bei diesen Versuchen wurde die Lüftung der Fahrzeuge verschieden eingestellt. Für die Messungen wurden Fahrten durchgeführt, bei denen nicht geraucht wurde und Vergleichsfahrten, bei denen innerhalb von 20 Min. 4 Zigaretten geraucht wurden.

Die Ergebnisse lassen einen deutlichen Anstieg der CO-Konzentration während des Rauchens erkennen. Ebenso deutlich ist der schnelle Abfall der Konzentration auf die Umgebungswerte direkt nach dem Rauchen. Während des Fahrens wurde der MAK-Wert nicht erreicht.

THE PROBLEM OF PASSIVE SMOKING IN MOTOR CARS

H.P. HARKE

Forschungsinstitut der Cigarettenindustrie, Hamburg, Federal Republic of Germany.

ABSTRACT - Interest is growing in the effect of tobacco smoke on air pollution in confined spaces. From 1969 onwards several projects have appeared containing reports of measurements of the smoke components in confined spaces and their connection with the amount of exhaled tobacco smoke and ventilation. These have related mainly to CO and nicotine, which are particularly important toxicological components of smoke. There have also been reports of tests to measure the reabsorption of these compounds by non-smokers. So far no investigations had been made in motor vehicles.

We therefore made measurements under controlled conditions in the wind tunnel in a medium-size European family car. The CO content within the vehicle, which was occupied by three smokers and one non-smoker, was measured continuously. The wind speed was adjusted so that speeds of 0 and 50 km/h were simulated. Windows and doors were completely closed while the ventilations grills were sometimes closed, sometimes open and sometimes open with the fan running. In one series of tests the subjects smoked three cigarettes each in an hour, always simultaneously, or, in another series of tests, two cigarettes each, one person after the other. The test conditions were such that there were no extraneous effects from the vehicles own exhaust or that of other motor cars.

To complete these investigations we measured the CO content in different types of cars on a selected section of roadway in Hamburg. The ventilation in the cars was also varied during these tests. To obtain the measurements, journeys were made when nobody smoked and then comparable journeys when four cigarettes were smoked within 20 minutes.

The results show a clear increase in the CO concentration during smoking. There is an equally clear rapid decline in the concentration to the ambient values directly after smoking. The MAC value was not attained during the journeys.

ANAESTHETIC VAPOUR POLLUTION IN OPERATING THEATRE ATMOSPHERES

R.S. BARRATT, R. BELCHER, W.I. STEPHEN, J.M. THOMPSON

University of Birmingham, U.K.

ABSTRACT - Evidence is accumulating to suggest potential occupational hazards to operating theatre personnel who are subject to prolonged exposure to inhalational anaesthetic agents. The reported effects of chronic exposure to these volatile organic compounds include an increased incidence of spontaneous abortion among anaesthetists and nurses, while the possibility that certain of these agents may be carcinogenec, teratogenic or mutagenic has been suggested. The published figures for levels of halothane in theatre air give a useful indication of the extent of the pollution, but numerous observers have expressed the desirability of a more extensive investigation of the problem together with more reliable data. This paper describes part of a comprehensive investigation to examine the exposure of theatre staff to pollution on operating theatre atmospheres by halothane, trichloroethylene and methoxyflurane vapours.

The extent of atmospheric pollution in the theatre is determined by a continual, electron capture gas chromatographic system in which air samples from remote locations in the room are analysed automatically at regular intervals. The influence of ventilation and scavenging systems on the pollution levels are important parameters. The advantage of a diffusion cell for the preparation of standard mixtures of anaesthetic vapours in air make this a useful technique for research with anaesthetics. The absorption of the atmospheric pollutants by the theatre staff during chronic and acute exposure is assessed by analysis of the blood levels of anaesthetics using a combination of solvent extraction and gas chromatography.

The fundamental experimental techniques which are essential for meaningful analytical data will be discussed and typical results indicating the distribution of the anaesthetic agents throughout the operating theatre will be presented.

THE CONTRIBUTION OF ORGANIC LEAD COMPOUNDS TO TOTAL LEAD LEVELS IN URBAN ATMOSPHERES

R.M. HARRISON, R. PERRY, D.H. SLATER

Public Health Engineering, Imperial College, London, U.K.

ABSTRACT - In making a full assessment of the health hazard to the community of airborne lead, it is essential to know both the levels at which the different lead compounds exist in what physical form they occur at a given location. Inter Alia it is thus neccessary to know

1. The proportion of the total lead present as organic lead compounds, in that the toxic hazards associated with such compounds are different from those due to inorganic lead compounds.
2. The size distribution of the inorganic lead particulates in the air, since the proportion of such compounds absorbed following inhalation is dependent amongst other things upon particle size.

Accordingly a method has been devised in this laboratory for the measurement of organic lead compounds in air, applicable at levels down to $0.01\ \mu g\ m^{-3}$ and involving sampling times of 30-40 minutes. This procedure involves initial filtration of an air sample through a conventional membrane filter, followed by passage through a cooled adsorption tube containing a specific G.C. column-packing material. Under controlled conditions quantitative collection of the organic lead compounds from the air samples occurs. Subsequent heating of the tube, with nitrogen elution, brings about volatilisation of the organic lead compounds which pass into the combustion air stream of an Atomic Absorption Spectrophotometer set up for lead measurement. Analysis of the particulates collected on the membrane filter allows for calculation of the inorganic lead content of the air.

Comparison of the results obtained in London using this method with those of other workers using classical chemical procedures involving long sampling periods revealed several interesting points. Although levels of particulate lead sampled under similar conditions appeared comparable, the proportion of lead in the organic form was consistently lower when measured by the adsorption tube technique described. This finding led to a more fundamental study of the alternative sampling and analytical procedures for organic lead. One focus for study was provided by the possible passage of smaller lead particles through the membrane filter. In addition, factors effecting the efficiency of collection and analysis using the adsorption tube technique, such as possible oxidation of organic lead compounds adsorbed in the tube or re-elution during sampling were given close examination.

ENQUETE PORTANT SUR LA CONSOMMATION FAMILIALE DE PESTICIDES DANS 30 FAMILLES HABITANT DE GRANDS ENSEMBLES DE LA REGION PARISIENNE. DOSAGE DES ORGANOCHLORES ORGANOPHOSPHORES DANS LES LIQUIDES BIOLOGIQUES DES PERSONNES INTERROGEES

C. PIVA - M.L. EFTHYMIOU - E. FOURNIER

Centre de Toxicologie-Hôpital Fernand-Widal, Paris, France

L'enquête porte sur les points suivants:

RESUME - présence de produits ménagers industriels ou de "jardin" dans l'appartement, en notant les marques, les quantités utilisées, et les lieux de rangement de ces diverses substances.

- existence de plantes, d'animaux domestiques, de parasites de toute sorte.

- recherche de séjour régulier à la compagne, possession d'une résidence secondaire avec éventuellement travaux de jardinage et consommation des produits cultivés, existence éventuelle dans cette résidence secondaire de produits pesticides.

- enfin, renseignements précis sur le lieu d'achat habituel des produits alimentaires (petit détaillant, marchand ambulant de fruits et légumes, magasin à succursales multiples, magasin à grande surface).

Les recherches biologiques pratiquées dans le sang s'orientent suivant les produits découverts pendant l'enquête, et de façon systématique vers la recherche d'organochlorés et d'organophosphorés (dosage des organochlorés, dosages des cholinestérases, voir même dosage des organophosphorés).

Ces dosages permettent d'avoir en toute première aproximation le taux sanguin moyen, ainsi qu'une corrélation éventuelle entre le taux sanguin et l'utilisation plus importante au sein d'une même famille.

SURVEY OF THE HUMAN CONSUMPTION OF PESTICIDES BY 30 FAMILIES LIVING IN URBAN DEVELOPMENTS IN THE PARIS AREA. ORGANOCHLORIDE AND ORGANOPHOSPHATE CONTENT OF THE TEST SUBJECTS BIOLOGICAL LIQUIDS

C. PIVA - M.L. EFTHYMIOU - E. FOURNIER

Centre de Toxicologie-Hôpital Fernand-Widel, Paris, France

The survey covers the following points:

ABSTRACT - the presence of industrial or "home-grown" household products in the apartment, noting brands, quantities used and where they are stored.

- the presence of plants, domestic pets and parasites of any kind.

- whether the test families pay regular visits to the country, whether they have a second house where they may possibly have a garden and consume produce grown in it, and the possible presence of pesticides in this second house.

- lastly, exact information as to where food products are bought (small retailer, mobile fruit and vegetable dealer, chain store, large store or supermarket).

The biological blood tests will depend on the products found during the survey and will take the form of a systematic investigation of organochlorides and organophosphates (organochloride content, cholinesterase content and even as organophosphate content).

These analyses will enable us to make a very first estimate of the average blood level, as well as to establish any possible correlation between blood level and the products mostly used in any one family.

APPLICAZIONE DELL'ANALISI SPETTRALE ALLO STUDIO DELLA DISPERSIONE DEGLI INQUINANTI ATMOSFERICI NELL'AREA DI VENEZIA

L. IOVENITTI, M. MENENTI, F. FERRARI-BRAVO, I. GIOVANNINI, A. LEVY

Gruppo Inquinamento Atmosferico, TECNECO S.p.A., FANO - Italia

RIASSUNTO - La ricerca mira alla valutazione dei meccanismi di dispersione atmosferica degli inquinanti nell'area di Venezia, in relazione ai valori di temperatura e di direzione e intensità del vento rilevati al suolo.

Applicando l'analisi di Fourier alle serie di due mesi di valori medi orari della concentrazione di SO_2, rilevati in 10 postazioni fisse, e di dati meteorologici, rilevati in 4 stazioni, sono state ottenute le caratteristiche spettrali dei dati di concentrazione e di quelli meteorologici.

Ulteriori informazioni sono state ottenute effettuando le analisi di crosscorrelazione, coerenza e fase tra serie di concentrazioni rilevate in coppie di stazioni opportunatamente selezionate. Sono state, inoltre, effettuate crosscorrelazioni miste tra serie meteorologiche e serie di concentrazione.

Benchè la ricerca sia ancora in atto, può essere anticipato qualche risultato preliminare.

Nel campo di frequenze sinottiche, sono stati individuati, sia negli spettri di potenza di concentrazione che negli spettri di vento, dei picchi in corrispondenza di periodi di 24, 42 e 67 ore.

Le analisi di coerenza e fase relative al picco di periodo 24 ore, estese a tutti i punti di misura, hanno permesso di formulare ragionevoli ipotesi sulla dinamica delle circolazioni locali delle brezze.

Sono stati individuati picchi significativi anche in corrispondenza a periodi minori di quelli indicati in precedenza; è in corso attualmente la interpretazione del loro significato.

APPLICATION OF SPECTRAL ANALYSES TO AIR POLLUTANT DISPERSION IN THE VENICE AREA

L. IOVENITTI, M. MENENTI, F. FERRARI-BRAVO, I. GIOVANNINI, A. LEVY

Air Pollution Branch, Tecneco S.p.A. Fano Italy

ABSTRACT - This research deals with the evaluation of the atmospheric dispersion mechanisms of pollutants in the Venice area in connection with wind and temperature patterns at ground level.

The spectral characteristics of the concentration data and of meteorological ones were obtained, by application of the Fourier analysis, from two months of hourly averaged concentrations of SO_2, recorded at ten fixed points in the industrial area as well as in Venice itself.

In addition, further information was obtained from the coherence and phase analyses of concentration time series between selected pairs of stations and finally, from the crosscorrelation between concentration data and meteorological ones.

Though the research is being continued, some preliminary results can already be anticipated. In the synoptic frequency range typical peaks were identified both in the SO_2 power spectra and in the wind spectra, at periods of about 24,42 and 67 hours. For the 24 hour peak, the coherence and phase analyses, which were extended overall the sampling stations, allowed us to formulate a reasonable hypothesis on the local breeze circulation.

Significant peaks were also revealed in the higher frequency range and their interpretation is underway.

STUDIO E VALUTAZIONE DEGLI EFFETTI DELL'INQUINAMENTO AMBIENTALE SULLA SALUTE DELL'UOMO ATTRAVERSO SIMULAZIONE CON MODELLI BIO-INGEGNERISTICO-CHIMICI

MARCO DEL BORGHI, GIUSEPPE FUMAROLA, R. GARDI, GIUSEPPE FERRAIOLO

Istituto di Scienze e Tecnologie dell'Ingegneria Chimica,
Università di Genova - Italia

RIASSUNTO - Sulla base dei più recenti studi a livello interdisciplinare che si collegano anche alle applicazioni biomediche dell'ingegneria chimica si propone un modello bio-ingegneristico chimico per la correlazione fisico-matematica esposizione-effetto ai fini della valutazione dell'inquinamento ambientale sulla salute dell'uomo.

Il modello è basato sulla applicazione della ben nota analisi compartimentale già con successo sperimentata nello studio della distribuzione, effetti e tollerabilità dei farmaci nel corpo umano concepito come uno o più reattori biochimici in serie-parallelo.

Il modello tiene conto al contempo dei principali parametri significativi ai fini degli effetti presunti o osservati sullo stato di salute dell'uomo quali: la concentrazione dell'inquinante, il tempo di esposizione, le caratteristiche intrinseche del soggetto esposto, in riferimento al tipo di veicolo (aria, acqua, alimenti, rumori) e per ciascun tipo di inquinante.

Il modello costituisce una alternativa di più rapida informazione, ad altri tutt'oggi adottati di tipo epidemiologico e statistico e sembra si possa ben prestare all'interpretazione delle alterazioni fisiologiche e del comportamento dell'uomo in seguito ad esposizione ad inquinanti.

Esso inoltre è un'utile risorsa per valutazione e previsioni significative sugli effetti: sinergici, antagonistici e addizionali degli elementi inquinanti sia a breve che a lungo termine.

210

STUDY AND ASSESSMENT OF THE EFFECTS OF ENVIRONMENTAL POLLUTION ON HUMAN HEALTH BY SIMULATION USING MECHANICAL BIOCHEMICAL MODELS

M. DEL BORGHI, G. FUMAROLA, R. GARDI, G. FERRAIOLO

Istituto di Science e Tecnologie dell'Ingegneria Chimica, Università
di Genova, Genova - Italy

ABSTRACT - On the basis of the most recent interdisciplinary studies concerning the biological and medical applications of chemical engineering, ideas have been put forward for a mechanical biochemical model designed to provide physical and mathematical correlations of exposure and effect, to assess the impact of environmental pollution on human health.

The model is based on the familiar analytical techniques already successfully tested in studies on distribution, effects and acceptable levels of drugs in the human body, and is in the form of one or more biochemical reactors in parallel series.

The model is designed to provide simultaneous measurements of the most important parameters indicating suspected or observed effects of pollution on human health, such as pollutant concentration, duration of exposure, and intrinsic characteristics of the exposed subject, relating these to the type of vehicle (atmosphere, water, food, noise), for each type of pollutant.

The model represents a faster-working alternative to the other epidemiological and statistical methods used so far, and it could well provide an excellent means of interpreting physiological and behavioural changes in man as a result of exposure to pollutants. Moreover, it provides a useful means of monitoring and making significant estimates of the synergic, antagonistic and cumulative effects, both short and long-term, of various pollutants.

A STATISTICAL ANALYSIS OF THE AIR POLLUTION DATA IN CONNECTION WITH THE METEOROLOGICAL CONDITIONS

D. YORDANOV

Geophysical Institute, Bulgarian Academy of Sciences, Sofia

ABSTRACT - The pollution in the planetary boundary layer (PBL) with a height of about 1 km is investigated. Under conditions of stationarity and a horizontal homogeneity of the underlying surface the turbulent state in PBL is fully determined by the following external to PBL parameters: Rossby's number, the external parameter of thermal stratification and two external parameters of the baroclinicity. These parametrs may easily be determined by the synoptic information. In the work it is looked for the relation between these representative for the diffusion process parameters and the data on the air pollution in different cities for a few year period of observation. It is shown that there exists a close relation between the external to PBL parameters and the air pollution.

Thus, for example, at Rossby's number smaller than 3.10^{-4} and external parameter of stratification bigger than 200, cases of strong air pollution are observed.

These investigations give a possibility by data on the numerical weather forecast to predict the cases of strong air pollution, especially important for the industrial city regions since the necessary preventive measures can be duly undertaken.

IL CONTENUTO DI PIOMBO NEI CAPELLI COME INDICE DI ESPOSIZIONE AL TOSSICO DELL'AMBIENTE

S. CACCURI, L. PECORA, A. ROSSI

Istituto di Medicina del Lavoro dell'Università di Napoli, Italia

---

RIASSUNTO - E' stato ricercato il contenuto di piombo nei capelli in diversi gruppi di individui divisi per età, luogo di abitazione, attività lavorativa, tenendo anche conto di soggetti che erano a contatto diretto con il tossico.

I risultati finora ottenuti mostrano differenze significative fra i vari gruppi, e un rapporto lineare fra l'assorbimento del piombo e il suo contenuto nei capelli.

Questo tipo di indagine può costituire un mezzo semplice, ma efficace, per la valutazione dell'esposizione al piombo di grandi masse di popolazioni.

LEAD CONTENT OF HAIR AS AN INDEX OF EXPOSURE TO LEAD PARTICLES IN THE ATMOSPHERE

S. CACCURI, L. PECORA, A. ROSSI

Institute of Industrial Medicine, University of Naples, Italy

ABSTRACT- Research was carried out on investigating the lead content of hair of various groups of individuals broken down by age, place of residence, and working activities, as well as subjects who were in direct contact with the poison.

The results obtained to date show significant differences between the various groups investigated and a linear relationship between lead absorption and its content in the hair.

This type of enquiry could constitute a simple but effective means of evaluating the exposure to lead of large sections of the population.

APPLICATION OF LEAD MOBILIZATION FOR EXPOSURE EVALUATION

LJULICA GRAOVAC-LEPOSAVIC, D. DJURIC, S. MILIC

Institute of Occupational and Radiological Health
11 000 Beograd, Deligradska 29, Yugoslavia

ABSTRACT - Various parameters indicating the level of lead exposure are followed in different groups of persons:

1. Inhabitants living around a lead-smelting plant showing whole life exposure to lead concentrations higher than normal,
2. workers exposed to high lead concentrations for some months,
3. workers exposed to high lead concentrations for some years.

For mentioned groups here following analyses are selected for presentation:

- determination of lead, ALA and coproporphyrin in the urine,
- determination of stippled red cells, retyculcytes, haemoglobin and erythrocytes in the blood (in some cases also lead in blood),
- lead mobilization using $CaNa_2EDTA$ injection was performed and lead in the urine before and in 24-hour sample after the injection was determined.

Obtained results are discussed taking into the consideration the duration of the exposure. Authors are pointing out that all presented parameters are useful for evaluation of the short exposure to lead. On the other hand, lead mobilization is valuable for evaluation of the integral lead exposure from the birth.

BEZIEHUNGEN ZWISCHEN RAUMLUFTKONZENTRATION, BLUTSPIEGEL UND METABOLITENAUSSCHEIDUNG AROMATISCHER LOESUNGSMITTEL.

D. SZADKOWSKI

Zentralinstitut für Arbeitsmedizin der Gesundheitsbehörde
der Freien und Hansestadt Hamburg - B R D

KURZFASSUNG - Ein Vergleich von Raumluftanalysen mit den zugehörigen MAK-Werten ermöglicht für viele toxische Substanzen eine Beurteilung des gesundheitlichen Risikos. Bestimmungen des jeweiligen Schadstoffes im Blut erlauben darüber hinaus eine Aussage zur individuellen Belastung. Deren Abschätzung durch Messung der Metabolitenausscheidung ist bei Routineuntersuchungen mit einer gewissen Unsicherheit behaftet, da ein Sammeln des 24 Stunden-Harns meist nicht durchführbar ist.

Um den Beziehungen zwischen dem Gehalt von Toluol der Raumluft, seiner Konzentration im Blut und der Metabolitenausscheidung im Harn nachzugehen, wurden bei 94 Beschäftigten einer Druckerei Bestimmungen dieses Lösungsmittels im Blut und seines Metaboliten Hippursäure im Harn durchgeführt und den gleichzeitig durchgeführten Raumluftmessungen gegenübergestellt. Bei einem Vergleich der gemessenen Toluolkonzentrationen in der Raumluft mit dem MAK-Wert für Toluol erschien arbeitsmedizinisch-toxikologisch die Belastung relativ gering. Trotzdem waren die mittleren Toluolkonzentrationen im Blut gegenüber den Werten einer Kontrollgruppe stark erhöht. Ebenso zeigten die Hippursäureausscheidungen der toluolbelasteten Probanden statistisch signifikant höhere Werte als das Vergleichskollektiv.

Als generelles Manko der Raumluftbestimmungen wird die Notwendigkeit angesehen, für repräsentative Aussagen über eine potentielle Gefährdung kontinuierliche oder gehäufte diskontinuierliche Messungen durchzuführen. Selbst bei einem derartigen Vorgehen bleibt es aber offen, wie kurzfristige Spitzenwerte für die Beurteilung eines Arbeitsplatzes in Rechnung zu stellen sind. Eine eventuelle perkutane Resorption kann bei alleinigen Raumluftanalysen die Beurteilung der Belastung erheblich erschweren. Diese Einschränkungen gelten für eine Bestimmung des Lösungsmittels im Blut im wesentlichen nicht. Weitere Zusammenhänge, auch hinsichtlich der Hippursäureausscheidung im Harn, werden in dem Referat diskutiert.

RELATIONSHIP BETWEEN THE CONCENTRATION IN AIR. THE BLOOD LEVEL AND THE SECRETION OF METABOLITES OF AROMATIC SOLVENTS

D. SZADKOWSKI

Central Institute for Industrial Medicine of the Public Health Authorities to the Free and Hanseatic City of Hamburg - Federal Republic of Germany

ABSTRACT - A comparison of the analyses carried out on air in enclosed spaces with the appropriate MAC values makes it possible to assess the health hazards presented by many toxic substances. In addition, determination of the specific toxin in the blood enables a statement to be made on the degree to which the individual is affected. Estimating this by measuring the secretion of metabolites during routine checks is rather uncertain, because it is usually not practicable to collect the urine of a 24-hour period.

In order to investigate the relationships between the toluene content of the air in the enclosed space, its concentration in the blood and the secretion of metabolites in the urine, determination of this solvent in the blood and of its metabolite hippuric acid in the urine was carried out on 94 employees of a printing works and compared with readings of the air in the room taken at the same time. When comparing the toluene concentration measured in the air in the room with the MAC value for toluene, the charge seemed relatively slight from an industrial medicine and toxicological viewpoint. Despite this, the average toluene concentrations in the blood were very much higher than the figures for a control group. The secretiions of hippuric acid in the test persons affected by toluene were statistically significantly higher than those in the group used for comparison.

The need for continuous or very frequent readings in order to permit representative estimates of a potential hazard, is considered to be a general drawback of the determination of air in enclosed spaces.

Even when following a procedure of this nature, it is, however, not clear, how temporary peak figures are to be accounted for in assessing a work place. With single analyses of the air in the room a possible percutaneous resorption can considerably complicate the assessment of the degree to which a person is affected. These limitations do not in the main apply to a determination of the solvent in the blood. Further connected aspects, including the secretion of hippuric acid in the urine, are discussed in the paper.

HOW USEFUL ARE THE BULK OF ENVIRONMENTAL DATA?

JON C. VAN LOON

Institute of Environmental Studies and the Departments
of Geology and Chemistry University of Toronto, Toronto M5S 1A1

ABSTRACT - It is crucial in the setting of environmental or health standards that a reliable data bank be available. Unfortunately a review of the literature on most pollutants reveals that there is frequently no way to judge the validity of the numbers which are given. Reasons are poor documentation and control of sampling, sample preparation and the subsequent analysis.

The inadequacies of data have been demonstrated frequently but never more clearly than in the case of mercury pollution problems around the world. Mercury analyses have been done routinely for most of this century. Much of the work was undoubtedly carried out using so-called "Standard Methods", commonly available from health and pollution control organizations. However it was only subsequent to the 1953 Minamata incident that the true chaotic nature of mercury data was revealed. In fact the literature shows that as recently as 1971 little agreement could be found even on the choice of the analytical method.

The Niigata report (1) in 1967 shows variations between neutron activation (NA) and dithazone mercury values, for the same sample, of up to 100%. In 1970, 13 laboratories analyzed a mercury spiked, flour sample by the same method (NA) (2). A mean value of 4.6 ppm was obtained with a range of values for 10 of the 13 laboratories of 1.4 ppm. The other laboratories were outside this range, one giving a value deviating from the mean by 50 times. In 1971 two homogenized fish samples were analyzed by (NA) and flameless atomic absorption spectroscopy (FAAS) (3).

Results showed that although the mean values for each technique were close, 1.37 ppm (FAAS), 1.36 ppm (NA) for sample 1 and 0.11 ppm (FAAS), 0.10 ppm (NA) for sample 2 there was a wide range of values submitted by the laboratories, 0.9 to 1.8 and 0.03 to 0.21 respectively.

In many countries there are mercury standards for food e.g. 0.5 ppm in the USA and Canada. In the light of the above variability one might wonder how such standards can be established and how they can be enforced. It must also be remembered that the uncertainty shown above will be amplified when variability in sampling procedures are also considered.

In this presentation evidence of deficiencies in other health related data banks e.g. blood lead values will also be discussed. Suggestions will be made regarding a more rational approach in the future.

./.

Literature Cited

(1) I. Kawasaka Report on the Cases of Mercury Poisoning in Niigata, Part II 1967, Ministry of Health and Welfare Tokyo Japan.

(2) A. Tugsuval, D. Merten and O. Suschng, The Reliability of low Level Radio Chemical Analyses March 1970 IAEC Vienna Austria.

(3) J.F. Uthe, F.A.J. Armstrong and K.C. Tam, Determination of Trace Amounts of Mercury in fish tissue: Results of a North American Check J.Ass Office. Ass Office. Anal. Chem. 1971, P. 866.

AUSWIRKUNGEN DER BLEI-UMWELTKONTAMINATION AUF LEBENSMITTEL VON SCHLACHTTIEREN - EIN BEITRAG ZUR PROBENAHME, UNTERSUCHUNG UND BEURTEILUNG.

W. KREUZER, B. SANSONI, W. KRACKE, F. DIETL, P. WISSMATH

Gesellschaft f. Strahlen- und Umweltforschung, Inst. f. Strahlenschutz
8-München-Neuherberg, Ingolstädter Landstrasse,
Bundesrepublik Deutschland.

KURZFASSUNG - Bei seiner hohen Toxizität für den menschlichen Organismus und der Neigung, sich in bestimmten seiner Gewebe zu akkumulieren, beansprucht Blei derzeit vor allem als Folge der gestiegenen Belastung unserer Umwelt durch Autoabgase als potentieller Rückstandsbildner in lebensnotwendigen Nahrungsmitteln tierischer Herkunft besondere lebensmittelhygienische Aufmerksamkeit.

Im Interesse des Konsumentenschutzes erwägt deshalb die BRD die Festlegung zulässiger Pb-Höchstwerte in Lebensmitteln. Der Entwurf einer "VO über Umweltkontaminanten" sieht dafür vor: in Fleisch $< 0,05$ und in Innereien $< 0,3$ ppm/Fg. Sie waren Veranlassung, ab 1972 die Pb-Kontaminationen in Fleisch, Leber und Nieren von Schlachtrindern in Abhängigkeit von Alter, Geschlecht, Rasse, Haltung, Fütterung, Jahreszeit und metereologischen Einflüssen zu untersuchen. Die Tiere stammten aus einem vorwiegend landwirtschaftlich strukturierten Gebiet des schwäbisch-bayerischen Voralpenraumes mit Weidehaltung der Rinder im Sommerhalbjahr, das als repräsentativ für einen Grossteil landwirtschaftlicher Gebiete Mitteleuropas angesehen werden kann. Den bisher untersuchten 160 Rindern wurden je Tier jeweils loo g schwere Proben Nierengewebe aus der linken Niere, Leber vom Lobus caudatus und Fleisch aus der Oberschale entnommen. Die Bestimmung des Bleis erfolgte nach nasser Mineralisation des Untersuchungsmaterials mit HNO_3 suprapur und H_2O_2 nach einer Arbeitsvorschrift von Sansoni-Kracke flammenlos atomabsorptionsspektrometrisch im Graphitrohr.

Die Nachweisgrenze für die Bestimmung des Bleis liegt bei 50 ppb, die Ausbeute zwischen 85 - 95 %. Der Gesamtfehler beträgt $<$10 %.

Die Nieren weisen im Durchschnitt die höchsten Pb-Konzentrationen auf, gefolgt von Leber und Fleisch. Die Einzelwerte schwankten in den Nieren zwischen 0,1 und 2,72 und in den Lebern zwischen 0,06 und 0,96 ppm Pb/Frischgewicht (=Fg). In Fleisch lagen sie, von wenigen Ausnahmen abgesehen stets unter 0,05 ppm.

In Nieren und Lebern streuten die Einzelwerte i.d.R. um $\pm$ 100 % und mehr.

Auch innerhalb der Organproben eines Tieres bestanden ähnlich grosse Schwankungen. Vermutlich trifft das auch für Fleisch zu.

Die grosse Streubreite der Pb-Konzentrationen dürfte primär individuell bedingt sein, da eine Abhängigkeit von Rasse, Alter, Geschlecht, Haltung, Fütterung, Jahreszeit und metereologischen Fakten bis jetzt noch nicht festgestellt werden konnte, wenn auch Nieren und Lebern älterer Tiere

oder in unmittelbarer Strassennähe gehaltener Rinder nicht selten etwas höhere Pb-Konzentrationen aufwiesen. Auch muss vermutlich in sehr trockenen Jahren mit höheren Bleiwerten gerechnet werden.

Ein Vergleich mit den im Entwurf der "VO über Umweltkontaminanten" für Fleisch und Innereien vorgesehenen zulässigen Pb-Höchstwerten zeigt, dass er bei den untersuchten Schlachtrindern in den Nieren häufig und in den Lebern gelegentlich überschritten wurde, der für Fleisch dagegen nur selten. Ein Ueberdenken der in Aussicht genommenen Pb-Toleranzwerte wird deshalb empfohlen.

EFFECTS OF LEAD CONTAMINATION OF THE ENVIRONMENT ON THE FOOD OF ANIMALS INTENDED FOR SLAUGHTER; SAMPLING, ANALYSIS AND ASSESSMENT

W. KREUZER, B. SANSONI, W. KRACKE, F. DIETL, P. WISSMATH

Gesellschaft f. Strahlen- und Umweltforschung, Inst. f. Strahlenschutz
8-München-Neuherberg, Ingolstädter Landstrasse,
Bundesrepublik Deutschland.

ABSTRACT - With its high toxicity to man and its tendency to accumulate in particular human tissues, lead claims special attention today in the food hygiene field as a potential former of residues in essential foods of animal origin, mainly because of the increased pollution of the environment by vehicle exhaust gases.

In the interests of consumer protection, the Federal Republic of Germany is therefore considering whether to establish maximum permissible levels of lead in food. The draft Regulation on environmental contaminants stipulates <0.05 ppm in meat and <0.3 ppm in offal (fresh weight). Starting in 1972 these prompted studies on lead contamination in the meat, liver and kidneys of slaughtered cattle, as a function of age, sex, breed, pasturage, fodder, season and weather. The animals came mainly from a predominantly agricultural subalpine area of Swabia and Bavaria, where cattle are put out to pasture during the six-month summer period. This area can be considered as representative of most agricultural areas of central Europe. In the case of each of the 160 cattle investigated to date, 100 g specimens of tissue were taken from the left kidney, liver from the lobus caudatus and flesh from the buttocks. The lead was determined by atom absorption spectrometry under flame-free conditions in a graphite tube, after wet mineralisation of the material with high purity HNO_3 and H_2O_2, using a specification of Sansoni and Kracke.

The limit of detectability of lead is about 50 ppb, and the yield 85-95%. The total error is $<10\%$.

The kidneys show the highest lead concentrations on average followed by liver and flesh. Individual values in the kidneys ranged from 0.1 to 2.72, and in the liver from 0.06 to 0.96 ppm Pb/fresh weight. With a few exceptions, the values for flesh were always below 0.05 ppm.

In the livers and kidneys the individual values as a rule showed a scatter around ± 100 %, or more.

Similarly wide variations were also found within organ samples from a single animal, and the same is presumably true for flesh.

The wide range of scatter of lead concentrations must depend primarily on individual characteristics, because so far it has not been possible to establish a correlation with breed, age, sex, pasturage, fodder, season or weather, although the kidneys and livers of older animals, or those kept in the immediate vicinity of roads, not infrequently show somewhat higher lead concentrations. Presumably, too, higher lead values are to be expected in very dry years.

./.

Comparison with the maximum permissible lead values for meat and offal stipulated in the draft Regulation on environmental contaminants shows that in the slaughter cattle under study these levels were frequently exceeded in the kidneys and sometimes in the livers, but seldom in the flesh. It is therefore recommended that further thought be given to the contemplated lead tolerances.

IDENTIFICATION ET LOCALISATION DE FINES PARTICULES MINERALES DANS DES MILIEUX BIOLOGIQUES AVEC LE MICROSCOPE ELECTRONIQUE A BALAYAGE

*J. GONI, P. JEANROT, G. REMOND, **J. BIGNON, ***G. BONNAUD

*Service géologique national (BRGM) - BP 6009 - 45018 Orléans cédex
**Clinique pneumo-phtisiologique de l'hôpital Laënnec - 42 rue de Sévres
Paris
***Direction Action sanitaire et sociale - Préfecture de Paris
37 bd St Marcel

RESUME - Le microscope électronique à balayage (MEB) présente de nombreux avantages pour mettre en évidence diverses propriétés physiques et chimiques de la matière:

- possibilité d'examiner en microscopie électronique transmise par balayage, des matériaux préparés sous forme de coupes de plusieurs milliers d'angströms d'épaisseur. Le détecteur qui a été réalisé et installé sur le MEB est décrit;

- possibilité d'analyser qualitativement par spectrométrie de rayons X de fines particules minérales incluses dans les tissus biologiques. Ceci est possible grâce à l'utilisation de spectromètre dispersif d'énergies utilisant la détection par diode Si (Li). Il permet d'obtenir des informations dans des conditions d'exitation telles que le rendement de l'émission X serait trop faible pour être analysé avec un spectromètre conventionnel. Les limites de résolution spatiale et de sensibilité de l'analyse ponctuelle sont discutées.

Les résultats obtenus au MEB sont discutés par rapport à l'ensemble des informations que l'on peut obtenir avec les techniques actuelles qui utilisent les procédés d'irradiation ponctuelle par des faisceaux électroniques.

IDENTIFYING AND LOCALISING FINE MINERAL PARTICLES IN BIOLOGICAL MEDIA BY SCANNING ELECTRON MICROSCOPE

*J. GONI, *P. JEANROT, *G. REMOND, **J. BIGNON, ***G. BONNAUD

* National geological Service (BRGM) - 45018 Orléans
** Pneumo-phthisiological clinic of the Laennec Hospital - Paris
*** Health and Social Action Directorate - Préfecture de Paris - France

ABSTRACT- The scanning electron microscope (SEM) has numerous advantages for revealing various physical and chemical properties of matter;

- it is possible to examine by scanning electron microscopy materials prepared in the form of sections several thousand angestroms thick. This work described the detector built and mounted on the SEM;
- it is possible to analyse qualitatively by x-ray spectrometry fine mineral particles contained in biological tissues. This is made possible by the use of an energy dispersion spectrometer with Si (Li) diode detection. It is possible to obtain information in excited states such that the yield of the X emission would be too weak to be analysed by conventional spectrometry. The limits of spatial resolution and sensitivity of the focused analysis are discussed.

The results obtained from the SEM are discussed in relation to the total information which can be obtained by current techniques, using focused irradiation methods with electronic beams.

MICRO DETERMINATION OF TOXIC METALS IN BIOLOGICAL MATERIALS

D.G. MITCHELL, K.W. JACKSON, K.M. ALDOUS

New York State Department of Health
Division of Laboratories and Research
New Scotland Avenue, Albany, New York

ABSTRACT - A new Delves cup technique has been developed for determining toxic metals in biological material, particularly tissue material. The technique offers several advantages over previous methods: (1) It eliminates the time-consuming and contamination-prone steps of off-line sample digestion and solvent extraction, which are frequently required even with the carbon-rod analyzer and graphite furnace micro atomic absorption techniques.

The on-line preliminary digestion procedure is simple and rapid. (2) It can also be used to determine nonvolatile metals, such as copper, iron and manganese, and to determine metals in water and air particulates. (3) Elimination of extensive sample pretreatment greatly improves the reliability and precision of analytical data.

Briefly, the sample for analysis is placed in a cup, and digestant is added (hydrogen peroxide, nitric acid - sulfuric acid, or nitric acid - perchloric acid). The cup is heated at 90-300°C until digestion is complete. It is then inserted into an air/acetylene or nitrous oxide/acetylene flame, where metals of analytical interest are atomized, and their integrated absorbances are measured. The efficiency of this technique is shown by its results with cadmium in kidney and liver tissue and with copper, zinc, and iron in serum and tissue.